

MSC 565

The American Journal of Surgery

Editor: THURSTON SCOTT WELTON, M.D., F.A.C.S.

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This Issue 210 Text Pages • 62 Illustrations

Diagnostic & Therapeutic Injection of the Sympathetic Nerves
By P. G. Flothow

Some Thoughts on the Problem of Cancer Control
By William B. Coley

Hysterosalpingography • By Albert Mathieu

Diagnostic Pneumothorax • By William B. Faulkner, Jr.

And Eight Other Original Articles

PART I (to be completed in three parts)

R. GUTIERREZ

"The Clinical Management of the Horseshoe Kidney"

EDITORIAL • Lest We Forget

BIOGRAPHICAL BREVITIES • Nélaton's Line

BOOKSHELF BROWSING • A Chat with Aesculapius
By W. B. Howell

BOOK REVIEWS

FINAL INSTALLMENT

R. A. CUTTING'S "The Principles of Preoperative and
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PORTRAIT OF AUGUSTE NÉLATON

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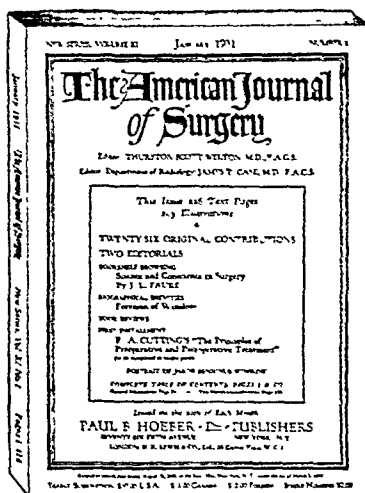
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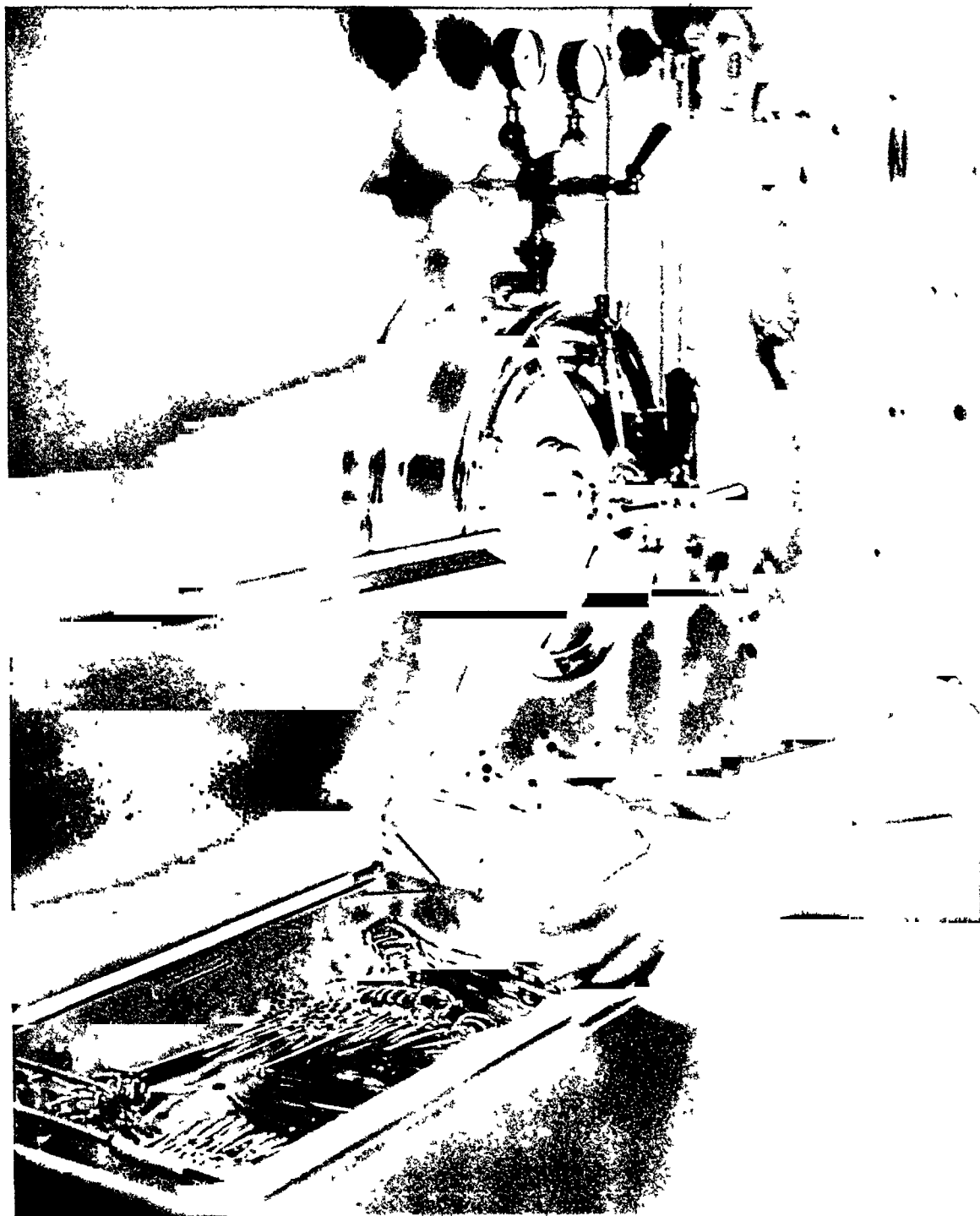
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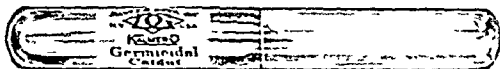
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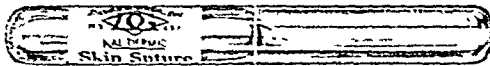


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GENERAL INFORMATION

Original articles are published only with the understanding that they are contributed exclusively to this Journal. Manuscripts offered for publication, correspondence relating to the editorial management and books for review should be sent to The Editor, THE AMERICAN JOURNAL OF SURGERY, 76 Fifth Avenue, New York, N. Y.

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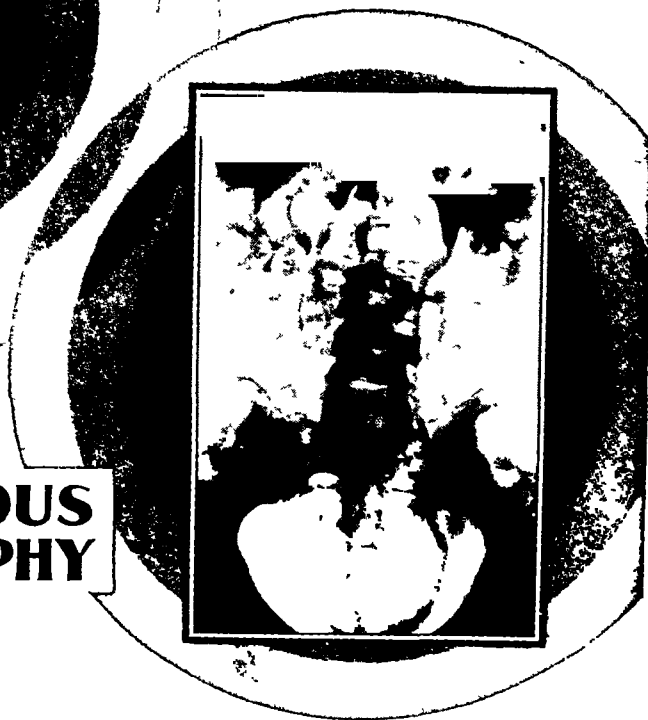
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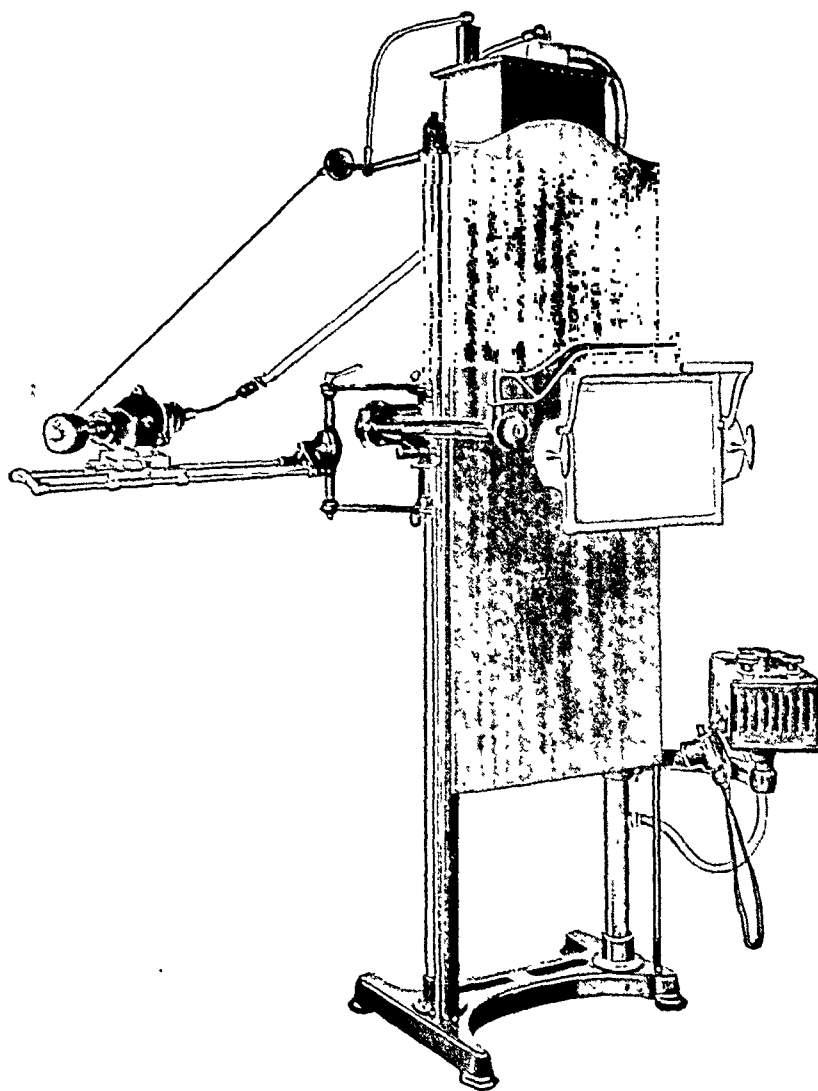


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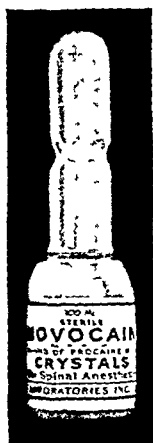
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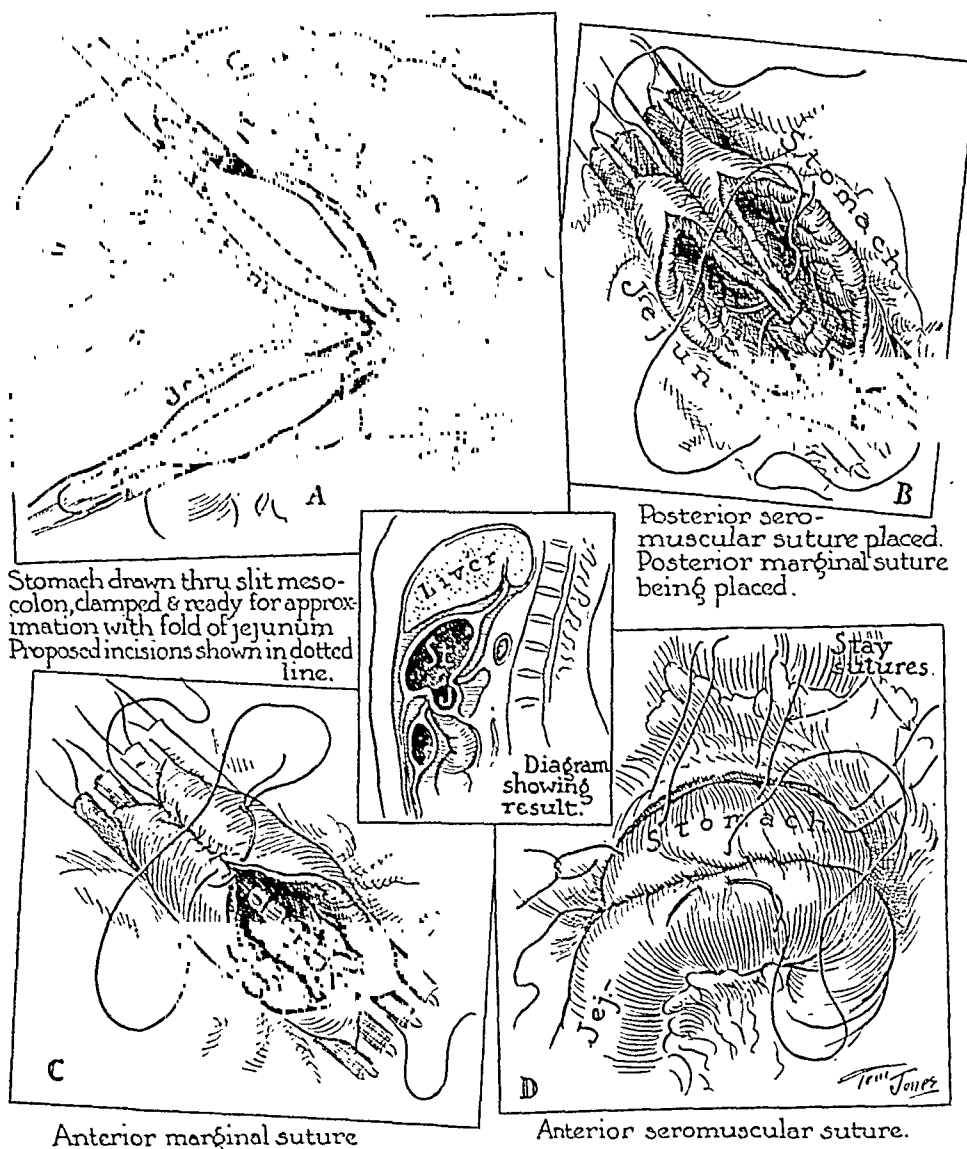
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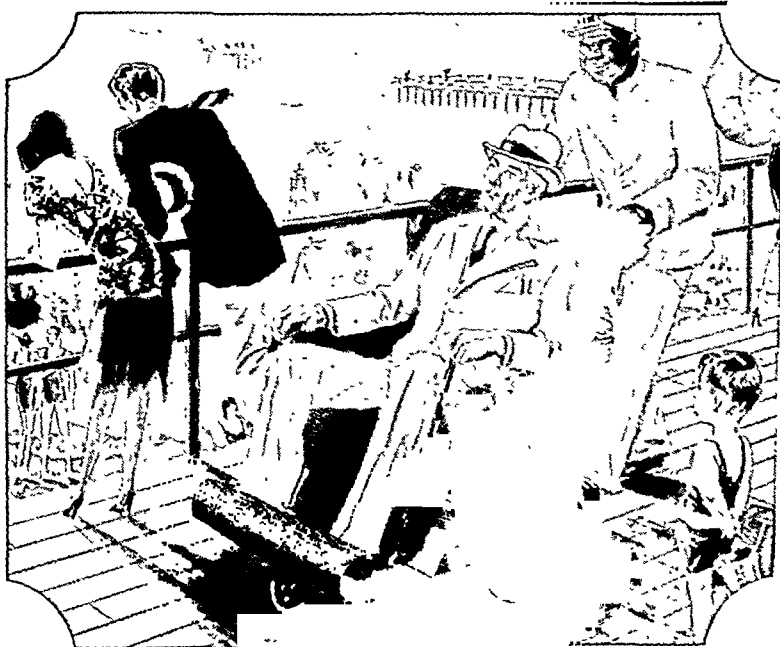
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Harris, F. I., and Bolze, E.: Basic principles involved in modern controllable spinal anesthesia. *California & Western Med.* 33:652, September, 1930.

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Russell, T. H.: Spinal anesthesia. *Am. J. Surg.* 6:201, 1929.

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Deal, D.: Choice of anesthesia. *Intermat. J. Med. & Surg.* 43:518, October, 1930.

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Bessesen, D. H.: The safety of spinal anesthesia. *Med. J. & A.* 131:567, June 4, 1930.

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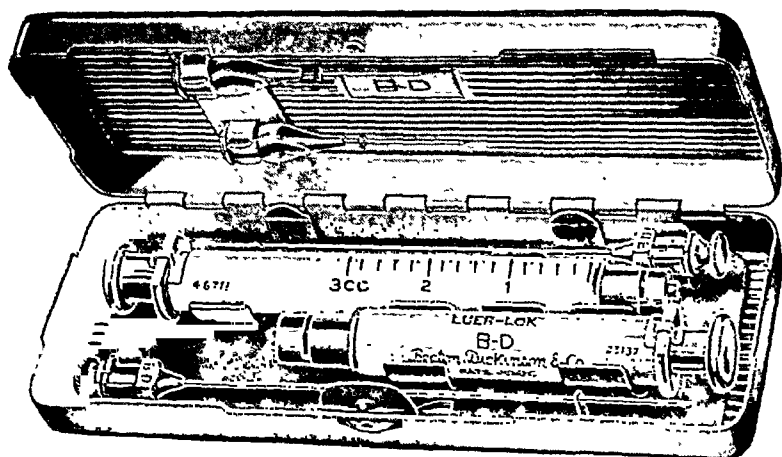
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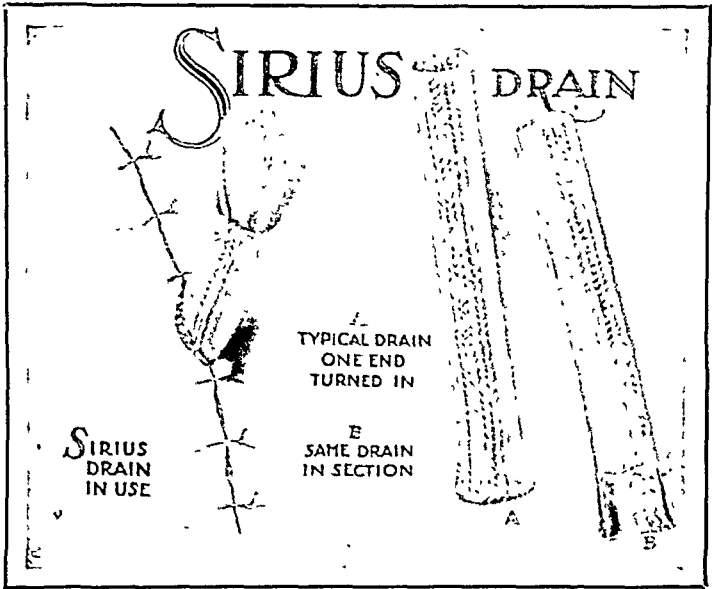
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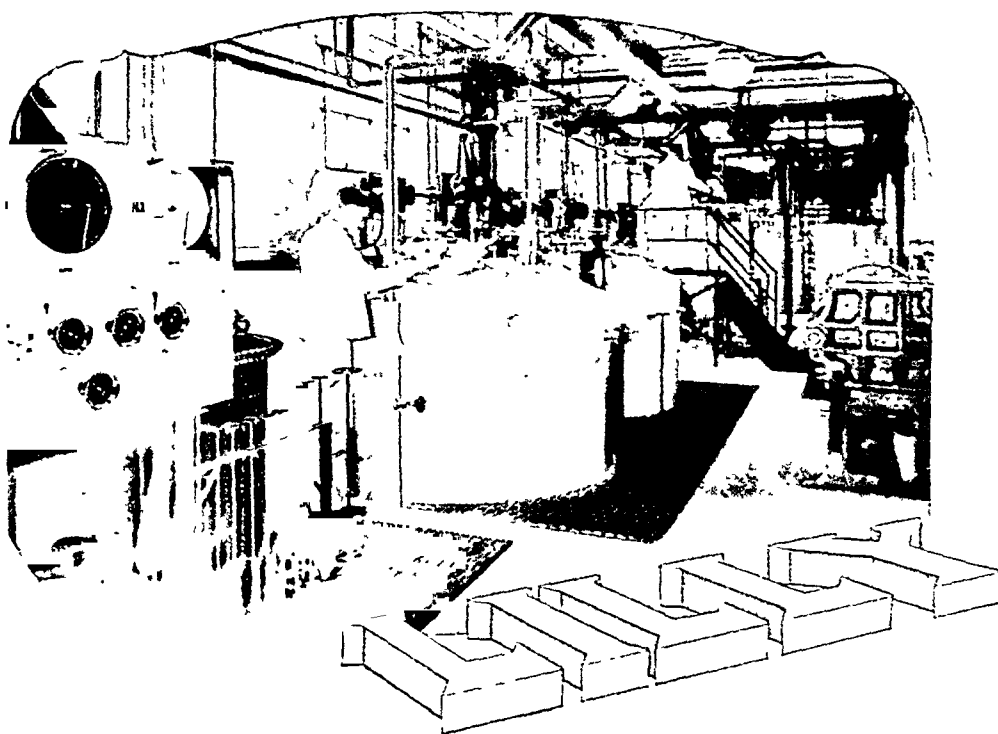
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DIAGNOSTIC AND THERAPEUTIC INJECTIONS OF THE SYMPATHETIC NERVES*

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SEATTLE, WASH.

THE two greatest objections to therapeutic measures directed toward the sympathetic nervous system have been the uncertainty and experimental nature of operative results, and the magnitude of the surgery.

The first objection has been overcome by the introduction of diagnostic injections to determine operability. The second objection still holds, but therapeutic injection of alcohol may be used in many instances to replace surgery.

DIAGNOSTIC INJECTIONS

Since the work of Brown,¹ White² and Mixer, Scott and Morton,³ Flothow,⁴ and others, on injection methods for diagnosis, operative procedures should not be undertaken without a preliminary diagnostic test; the only exceptions to this statement occur in the case of Hirschsprung's disease and in spastic conditions, where the time element plays an important part. Even in these conditions preliminary alcohol injection offers several months' ablation of the sympathetics in which to judge potential results from operating. This is particularly true in spastic conditions; the operative results in Hirschsprung's disease are so constant that diagnostic injections are not necessary.

There are several diagnostic injection methods available. The original fever test,

introduced by Brown, consists in the intravenous injection of typhoid vaccine to produce vasodilatation. There are several objections to this method: it causes a severe generalized reaction with nausea, vomiting, and extreme discomfort; it is an indirect test, producing only vasodilatation and does not give any information as to relief of pain. We feel that this test is the least reliable of any.

Spinal anesthesia is a simple method of producing vasodilatation, operability being determined by the degree of increase in temperature. This test is available only for the lower extremities and gives no indication as to pain relief since all pain fibers are anesthetized.

Direct injection of nerve trunks is effective but incomplete, as all sympathetic fibers are not interrupted.

The method which we prefer and use almost entirely is the direct injection of sympathetic nerves, the technique being simple and causing the patient very little discomfort. By anesthetizing at definite levels we can determine accurately what operative removal would accomplish. Its great advantage is in relation to pain, for if pain is relieved, either removal or alcohol injection will produce the same result. This is important in cases in which it is possible to relieve pain even though vascularity may be unimproved.

* From The Neuro-Surgical Clinic, Seattle, Washington.

Read before the Association of Residents and Ex-Resident Physicians of The Mayo Clinic, Rochester, Minnesota, October 10, 1931.

TECHNIQUE OF INJECTIONS

Lundy's⁵ method of injection is preferred since it is uniform for all portions of the

region, however, one is more apt to puncture the pleura or the dura than in Lundy's method. For lumbar injections the Labat

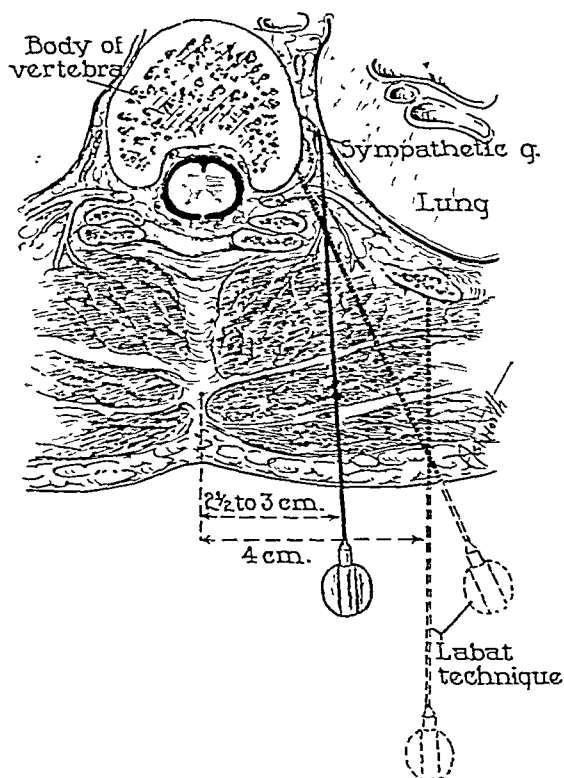


FIG. 1. Point of injection of needles in dorsal region. Showing Lundy method and Labat technique. (From Labat.)

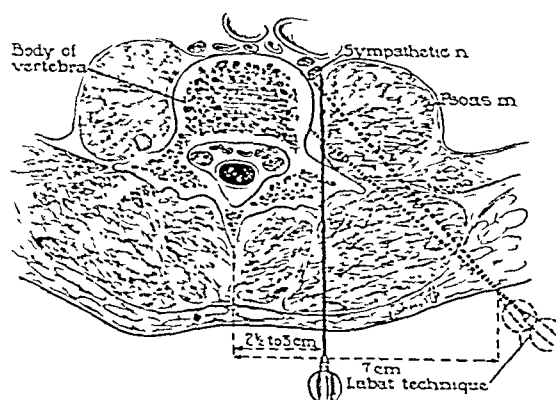


FIG. 2. Illustrating Lundy and Labat technique for lumbar injection. (From Labat.)

sympathetic chain. It is done in the prone position with the patient lying upon the abdomen, properly supported by pillows.

Labat's⁶ technique for paravertebral injection may also be used. In the dorsal

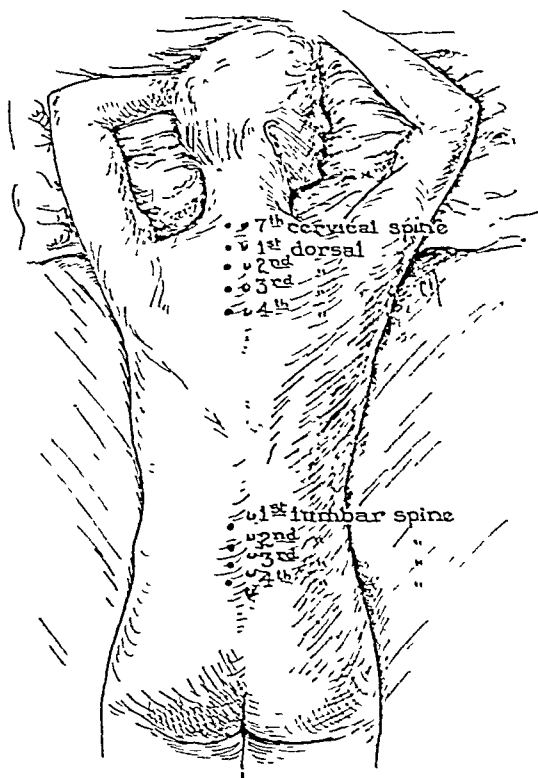


FIG. 3. Point of insertion of needles for dorsal and lumbar injections using Lundy technique. First dorsal segment lying opposite the seventh cervical spine, showing that dorsal injection is made opposite spine and lumbar injection opposite interspaces.

technique is an alternative if one is unable to strike the sympathetic chain by Lundy's technique.

In Lundy's method the point of insertion of the needles is approximately two fingers' breadth lateral to the midline, opposite the spines in the dorsal region, and opposite the interspaces in the lumbar region. The actual distance varies from $2\frac{1}{2}$ to 3 cm., depending upon the size of the bodies of the vertebrae, the object being to skirt the edge of the bodies closely in inserting the needles. The insertion is made perpendicularly until the transverse process is encountered. The needle is then angled so as to slide either just above or just below the transverse process, and then inserted two fingers' breadths deeper,

again from $2\frac{1}{2}$ to 3 cm., depending upon the size of the individual. Five cubic centimeters of one per cent procaine are de-

such instances the Labat approach for paravertebral injection can be employed, starting from a point 7 cm. from the mid-

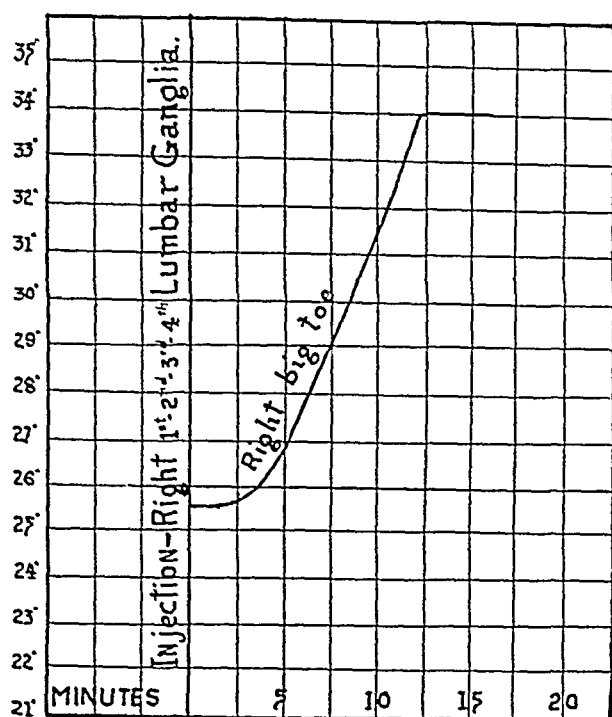


FIG. 4. H. E. Aged forty-seven. Diagnosis: (1) arteriosclerotic endarteritis; (2) Buerger's disease. Complaint: cold, painful extremities. Increase of 8.3°C . showing marked element of vasospasm. Complete relief of pain. Injection of alcohol resulted in complete relief with same increase in temperature.

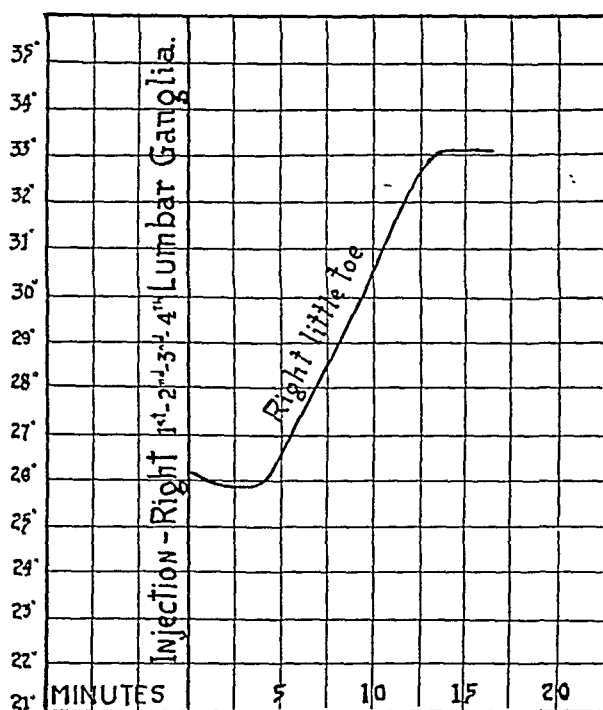


FIG. 5. V. J. Aged fifty-one. Diagnosis: arteriosclerotic endarteritis. Date: May 20, 1931. Complaint: cold, cyanotic feet, claudication. Increase of 7.0°C . Foot became warm and pink. Pain completely relieved. Alcohol injected.

posited into each needle and if the needles are properly placed, increased temperature of the extremity will be apparent in from five to fifteen minutes, depending upon how close to the sympathetic chain the points of the needles lie. If no temperature increase occurs within fifteen minutes, the needles should be withdrawn and reinserted either closer to the bodies of the vertebrae or at a slight angle toward the midline.

Two common reasons for failure are placing the point of the needle too far laterally or not deep enough. Failures are rare in the dorsal region since the sympathetic chain lies lateral to the bodies of the vertebrae. They are more common in the lumbar region where the chain lies more on the anterolateral aspect of the bodies of the vertebra or anteriorly. In

line and inserting the needle at an angle of 45° , then angling until it slides over the anterolateral surface of the body of the vertebra.

The procedure for diagnostic injection is as follows. The test should be done in a cool room, preferably about 60°F ., since in a hot room, where vasodilatation may be present, results would be misleading. The extremities to be tested are exposed for at least one-half hour to the room temperature before skin temperature readings are taken. In order to assure accuracy it is essential that some form of thermocouple be used, and for these readings we use a dermatherm. The needles are then inserted as follows: for conditions above the clavicles, the needles are placed opposite the seventh cervical, first and second dorsal spines; for the arms, opposite the first, second and third dorsal spines; for

the legs, opposite the first, second, third and fourth lumbar interspaces. When the needles are in place 5 cm. of 1 per cent

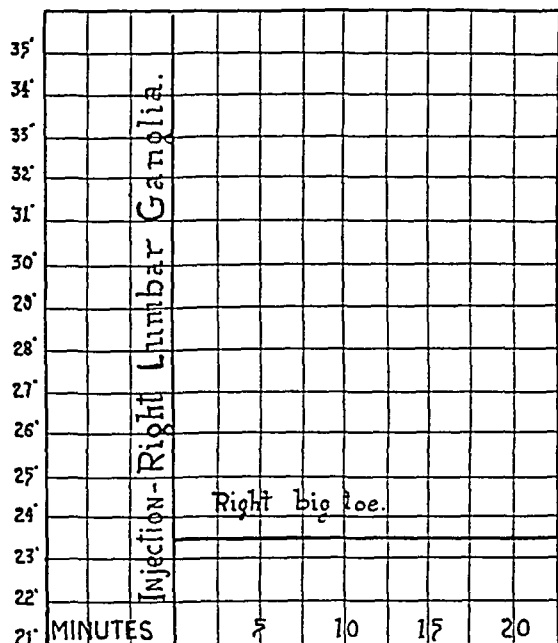


FIG. 6. H. R. Aged thirty-three. Date: Oct. 10, 1930. Complaint: Gangrene of right big toe. Severe pain. Diagnosis: Burger's disease. Result: no increase in temperature of toe. Leg warmed up to sharply limited area just below knee, from there down remained cold. Advised amputation above knee. Done.

procaine are deposited in each needle. Temperature readings are then taken at five minute intervals for twenty minutes, always using the uninjected extremity as a control. Pain may disappear before the vasomotor changes are apparent. We feel that a rise of at least 5°C . is necessary to indicate operation in conditions due to vascular insufficiency such as Buerger's disease and Raynaud's disease. Morton and Scott³ have given us a minimum vasodilatation level at 31.5°C . which is very important. Obviously, if the room is very warm with vasodilatation present before injection, there may be very little rise in skin temperature and therefore allowance should be made for the temperature of the room. If pain is relieved and the dermaterm readings show increase of from 5° to 10°C . in temperature, either alcohol injection or operation is indicated.

COMMENTS

One of the first cases in which we employed this diagnostic injection was a girl

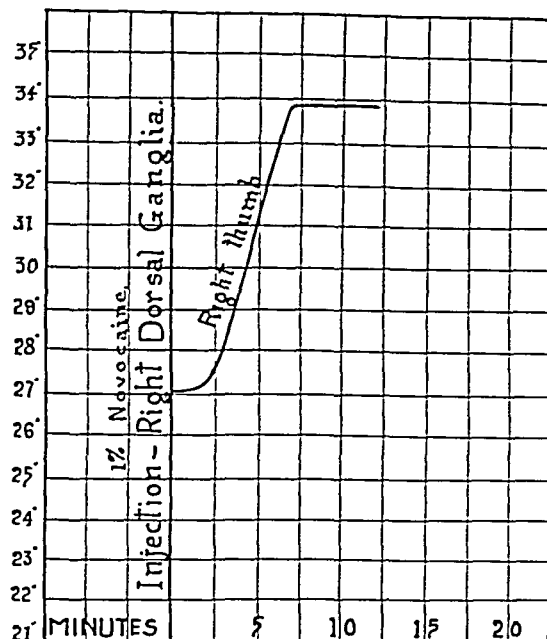


FIG. 7. H. N. Aged thirty-three. Date: May 13, 1930. Complaint: cold, blue painful extremities. Diagnosis: Raynaud's disease. Increase of 6.7°C ., showing marked vasospasm. Cold, blue, cyanotic hand changed to warm, pink one. Injection of alcohol.

twenty years of age, who, following an injury, developed a severe pain in her hand associated with bluish discoloration and excessive cold perspiration. Novocaine injection of the upper dorsal segments produced complete relief of pain, marked increase in temperature, and changed the blue, cold moist hand to one warm, pink and dry. Removal of the sympathetic ganglia in this case gave complete and lasting relief. This case has been reported in detail.⁷

To differentiate atypical facial pains it is only necessary to inject the inferior cervical and upper two dorsal segments. If pain is relieved, one may be sure that it is sympathetic in origin or transmission.

In thromboangiitis obliterans (Buerger's disease) operability is easily determined. A marked increase in temperature and relief of pain assures good results following operation or alcohol injection. If this

does not occur, amputation is indicated, and the diagnostic injection will give a definite level for amputation. If alcohol is injected it insures maximum blood supply and should lower the incidence of painful stump.

In Raynaud's disease the same holds true. The operative result is reproduced preoperatively by injection of the proper sympathetics. In scleroderma, so often associated with Raynaud's disease, the amount of temperature increase following injection is the criterion of operability.

In chronic arthritis, definite information may be obtained from the diagnostic injection. We have had several cases in which relief of pain, marked increase in joint function, and marked temperature increase followed injection. Operation in these cases reproduced those results.

In arteriosclerotic pain and gangrene, diagnostic injection is invaluable as many of these patients can be spared amputation. We shall take up this condition more fully in the discussion on therapeutic injections.

In trophic lesions of extremities, skin lesions, causalgias, intermittent claudication, painful stump, diabetic neuritis, and various other painful conditions of unknown origin, valuable information may be obtained from diagnostic injections which indicate therapeutic measures of proved worth.

To summarize: diagnostic procaine injections of the sympathetic nerves at various levels give us definite indications for successful treatment in a great variety of conditions. These injections have taken the guess work entirely out of the realm of sympathetic therapeutic measures.

THERAPEUTIC INJECTIONS

The scope of this paper is too great to allow a comprehensive discussion of every phase. The past two years have contributed a new therapeutic measure of great value in the alcohol injection of sympathetic nerves. We now have a method which has in many instances replaced the highly specialized operation of sympathetic gang-

lionectomy. It has made possible the successful treatment of a wide variety of conditions in which, owing to the risk, the magnitude of the operation, or the economic status of the patient, operation was not justified.

The substitution of injection for operation is not advocated except where operation is not warranted. We frequently meet borderline cases in which the diagnostic injection shows an uncertainty as to results from operation which would justify its use. In these cases one can use the injection of alcohol not only as a therapeutic measure but also as a glorified diagnostic procedure, the results of which may warrant operation later. Alcohol injection is reserved for those cases in which we feel that operation is contraindicated. We have done approximately fifty alcohol injections for a variety of conditions with excellent results.

In conditions such as Buerger's disease, Raynaud's disease, scleroderma, chronic arthritis, Hirschsprung's disease and spastic conditions where a complete and lasting denervation is essential, we remove the sympathetics surgically in suitable cases.

ARTERIOSCLEROTIC CONDITIONS

Since our recent report⁵ of the results of alcohol injections in 8 cases of arteriosclerotic pain and trophic conditions, 4 more have been done. The immediate results have been excellent to date, although the time elapsed has been too short to determine the lasting qualities of this treatment. It would seem that the pathologic process of this condition might preclude expectation of success, but, strangely enough, our results have been as good or better than in those conditions previously considered suitable for surgery or injection.

Alcohol injection is preceded as usual by diagnostic procaine injection. It is astonishing to find these patients obtaining almost instant relief of pain and marked improvement in circulation when procaine is injected. If this occurs, 5 to 7 c.c. of 95 per cent alcohol is injected in each needle and

gives permanency to the result. We have had 12 cases, 10 of which resulted in complete relief of pain and healing of trophic lesions. In one case gangrene was already present up to the ankle, and injection was done merely as a measure to promote maximum blood supply to the stump, amputation being considered urgent. Following the injection which preceded amputation by three days, there was an immediate demarcation and the marked edema which had been present had entirely disappeared. The other case was a complete failure, amputation disclosing complete obliteration of all vessels. It is obvious that if vessels are completely obliterated one cannot hope for improvement.

The injection in these cases is one of the most satisfactory phases of all our work, since previous to our discovery of the treatment, very little short of amputation gave relief.

In all cases where amputation is necessary due to vascular deficiency of any nature, amputation should be preceded by alcohol injection of the sympathetics to insure maximum blood supply to the stump, thus lessening the incidence of non-healing stump and insuring against painful stump. In a case of arteriosclerotic gangrene alcohol injection was done immediately preceding amputation, performed at an astonishingly low level in the face of evident very poor blood supply, healing resulting by primary intention.

In this group of cases injection is preferable to surgery owing to the age of the individual and the uncertainty of final results. It is probable that this treatment is only palliative for the process will probably extend and later necessitate amputation which, however, may be delayed several years as a result of the injection.

THROMBOANGIITIS OBLITERANS

We have not as yet used this method in a frank case. Some of the cases classified as arteriosclerotic in nature may have been thromboangiitis obliterans, since it seems impossible to differentiate the two condi-

tions in individuals over fifty years of age and we therefore classify these as arteriosclerotics.

Injection, rather than operation, should be employed in all cases where diagnostic methods indicate that operative results would be questionable or useless. Even where amputation is necessary it insures maximum dilatation of patent blood vessels and therefore maximum blood supply to the stump. When the case is a borderline one as to operability, alcohol injection will often produce such marked improvement as to warrant surgery.

RAYNAUD'S DISEASE

In a case of Raynaud's disease we employed alcohol injection of the sympathetics to the lower extremities as a palliative measure, because the patient, convalescing from bilateral dorsal ganglionectomy, did not wish to undergo another major operation for several months. The results of the injection to date are comparable to those of surgical removal.

CHRONIC POLYARTHRITIS

In 3 cases we have been running a comparative test, ganglionectomy being performed on one side, alcohol injection on the other, both in the upper and lower extremities. To the present time our results have been about the same as to relief of pain and improvement in joint function. As to increased vascularity, however, we have found that the operated extremities are maintaining a higher temperature than the injected ones and it is probable that operation will become necessary on the injected ganglia.

Patients uniformly prefer the operation to the dorsal injection because of the neuritis which follows the injection. This subject will be discussed more fully later.

TRIFACIAL NEURALGIA AND ATYPICAL FACIAL NEURALGIAS

In a case of typical tic douloureux, alcohol injection of the inferior cervical and upper two dorsal ganglia was done

with complete relief of pain for the six months in which we were able to follow the case. The patient had refused to have the sensory root sectioned after direct injection of the nerve failed to bring relief.

In a case of atypical facial neuralgia associated with pain in the neck, arm and shoulder, pain was relieved by alcohol injection of the sympathetics. This patient died about two months later of a cardiac condition so that we were unable to attach much significance to the result. We feel, however, that in view of the cases reported of recurrent trifacial pain after sensory root section relieved by sympathetic ganglionectomy (Flothow,⁹ Mixer and White¹⁰), that there is a very definite field for alcohol injection in these conditions. Reichert¹¹ reports such a case treated successfully.

ANGINA PECTORIS

White¹² has done more than anyone else in this disease. The results are most satisfactory. The results in the 3 cases we have to report, have been excellent, although too little time has elapsed since injection for a conclusive report; in each case, however, anginal pain has been relieved. There are several points of interest relative to this treatment. The cardiologist objects to the treatment because he feels that if pain is relieved the patient has lost his warning and death will ensue. Strangely enough, every case we have observed has been entirely relieved of pain but with a warning still present in a sense of suffocation or constriction on over-exertion.

For anginal conditions the upper five dorsal segments on the left side are injected. At times, it may be necessary to inject the right side also.

White reports several cases of painful aneurysm relieved by this method.

BRONCHIAL ASTHMA

We have but 1 case to report, but one of great interest to us because of the marked relief of the asthma and our only mortality to date.

The patient, a man fifty-one years of age, was practically in status asthmaticus, able to breathe sufficiently to sustain life only by a liberal use of adrenalin. Because no other form of treatment was of any avail we were asked to inject his sympathetics. It was necessary to do this with the patient sitting upright due to his extreme dyspnea. The upper three dorsal segments on each side were injected with 5 c.c. of 1 per cent procaine in each needle. The result was quite dramatic. Within a few minutes the asthma began to improve, and within fifteen minutes breathing was almost normal. Feeling that this result might be psychic, we decided not to inject alcohol, but to wait and see how long relief would last. After relief of approximately one hour, asthmatic breathing recurred more severely than before and did not respond as previously to adrenalin, and the patient expired in four hours.

Autopsy disclosed complete collapse of both lungs with bronchioles full of frothy substance. Unfortunately, we were not called until too late to reinject, for we believe that, had alcohol been injected, this patient would be alive and markedly relieved of his asthma.

The explanation of this result is conjecture, but we believe that when the anesthesia of the sympathetics wore off, there occurred a compensatory stimulating effect upon the sympathetics which was unaffected by adrenalin, resulting in complete constriction of the bronchioles.

Stern and Spivacke¹³ report a case of bronchial asthma in which unilateral alcohol injection was successful. From Europe come reports of good results following operative removal of the sympathetic ganglia.

TROPHIC ULCERS AND SKIN AFFECTIONS

Under this heading occur a variety of conditions which may be treated by alcohol injection. Many trophic conditions of unknown origin will undoubtedly respond to this treatment, and all conditions of this type for which the LeRiche method of operation is advocated can be more effectively and certainly benefited by alcohol injection.

One of our cases is of especial interest; a woman, fifty-six years of age, with a peculiar skin condition of many years' standing, her skin from the knees down resembling nothing so much as elephant's hide. The color was about the same, it was thick and wrinkled like elephant's skin, and very dry and scaly. A large ulcer on one leg about 3 in. in diameter would not heal, and severe pain in both legs was constantly present. The hospital staff, at a loss as to diagnosis and treatment, prevailed upon us to try an alcohol injection. A diagnostic injection resulted in prompt relief of pain and marked increase in temperature. Alcohol was then injected and to our surprise the skin condition rapidly began to clear up and the ulcer to heal. Within a week the ulcer had healed nearly 50 per cent, the wrinkles were leaving the skin, and where the scales were removed fairly normal skin appeared. The contrast to the uninjected side was very marked and two weeks later this side was injected. Approximately six weeks have elapsed; the ulcer is entirely healed, the skin is improving daily and relief of pain has persisted.

This case leads us to believe that neurotrophic skin lesions which do not respond to the usual treatment might be benefited by alcohol injection.

DIABETIC NEURITIS AND GANGRENE

In 2 cases of painful diabetic neuritis, one associated with gangrene, alcohol injection relieved the pain. In the case in which gangrene was present several toes had been amputated leaving a gangrenous sloughing area which would not heal and was associated with severe pain. Alcohol injection gave immediate relief of pain and the gangrenous area promptly began to granulate and within six weeks was practically healed.

We feel that at least diagnostic injection should be employed in all cases of diabetic gangrene which resist treatment.

MISCELLANEOUS CONDITIONS

Under this heading we are grouping a number of painful conditions which we have not had the opportunity of treating,

but which we feel would probably be benefited by alcohol injection.

MIGRAINE. Those cases in which the pain is definitely unilateral are worthy of at least diagnostic injection. Relief of pain should be followed by alcohol injection which would act not only as a therapeutic but as a diagnostic measure which, if effective, could be followed by surgery. Dandy's¹⁴ recent report of cases cured by operation bears this out.

PAIN IN MALIGNANCIES. A diagnostic injection will indicate whether or not alcohol injection should be done. Certainly this would be preferable to the operative treatment which has been advocated.

PAINFUL AMPUTATION STUMPS. We feel certain that a good percentage of these cases would respond to this treatment and suitable ones could easily be selected through diagnostic injection.

As a last consideration, we wish to suggest that any pain of vague and unknown origin may be carried over sympathetic channels. It is easy to determine if this is the case merely by a diagnostic injection. It is quite possible that a surprising number of successful results would be obtained.

COMMENTS

Untoward Results. In the main these are the same as those encountered in any procaine or alcohol injection. There are, however, some particularly relevant to alcohol injection, the most important being alcoholic neuritis, probably due to the exposure of somatic nerve roots to alcohol. In the dorsal regions this neuritis is often very severe and most annoying to the patient, usually lasting from two to six weeks, and is best treated by sedatives and heat. In the lumbar injections the neuritis occurs in only about half the cases and is usually not as severe.

In the dorsal region there is danger of penetrating the pleura and injecting alcohol intrapleurally. This has occurred to us once and the resulting pleuritic pain was so intense as to put the patient into shock,

TABLE I
DIAGNOSTIC INJECTIONS

No.	Date	Patient	Sex	Age	Diagnosis	Symptoms	Injection— Level	Temper- ature Increase	Relief— Pain	Novo- caine	Results and Comments
1	9-30-30	I. I.	M	45	Buerger's disease	Pain—gangrene following amputation toe	Labat L. lumbar	7.5°C.	Yes	20 c.c.	Ganglionectomy resulted in relief of pain and healing of gangrene
2	10-10-30	H. R.	M	35	Buerger's disease	Pain gangrene of big toe	Labat Rt. lumbar	0	0	20 c.c.	Increase of temperature to just below the knee, amputation
3	10-12-30	O. A.	F	20	Traumatic Raynaud's disease	Cold, blue, painful arm, following injury to hand	Rt. D. 1-2 Labat	18°F.	Yes	15 c.c.	Complete relief of pain and warming of hand. Ganglionectomy resulted in cure
4	12- 2-30	L. C.	M	39	Buerger's disease	Pain—loss of both legs and several fingers of each hand	Labat Lt. D. 1-2	3.5°C.	Yes	15 c.c.	Ganglionectomy relieved pain and healed gangrene
5	12-10-30	P. L.	M	21	Polyarthritis, Osteitis fibrosa cystica	Pain—ankylosis of all joints both legs	Lt. L. 1-2-3-4	not measured	0	20 c.c.	No relief of pain. Had a convulsion on table. Hopeless case
6	2- 5-31	W. M.	F	40	Polyarthritis	Marked arthritic pain. Cold clammy extremities	Lt. L. 1-2-3-4	12.3°F.	Yes	20 c.c.	Arthritic pain relieved and joint function increased markedly by ganglionectomy
7	3-26-31	R. H.	F	38	Neuritis of leg	Pain in tibia, unknown origin	Rt. L. 1-2-3-4	0	0	20 c.c.	Needles too short in very fat person. Sympathetics missed. Refused reinjection
8	5-22-31	J. V.	M	51	Bronchial asthma	Very severe. Adrenalin gave slight relief	Bilat. D. 1-2-3	not measured	—	30 c.c.	See text. Relief of asthma followed by death as anesthesia wore off
9	6-17-31	M. B.	M	67	Traumatic neuritis	Pain in foot at night for 14 years since ran nail into foot	Lt. L. 1-2-3-4	marked	No	20 c.c.	Marked increase in temperature, but no relief of pain
10	7-22-31	C. W.	F	55	Cancer of breast with brachial neuritis	Intense pain in arm and shoulder	Lt. D. 1-2-3	not measured	No	15 c.c.	No relief of pain. Marked temperature increase
11	7-22-31	C. M.	M	34	Cervical spondylitis	Severe pain in neck and back	Bilateral D. 1-2-3	not measured	No	30 c.c.	Marked increase in temperature. No relief of pain
12	7-22-31	M. M.	F	60	Polyarthritis	Severe pain in joints and neck	Rt. D. 1-2-3	not measured	No	15 c.c.	No relief of pain, therefore not suitable
13	8- 2-31	W. L.	M	42	Encephalitis lethargica	Pain and spasticity of arm	Rt. D. 1-2-3	5°C.	0	15 c.c.	No relief of pain or decrease in spasticity
14	8-13-31	W. C.	F	55	Indeterminate	Pain, twitching of face, numbness of face	Lt. D. 1-2-3	marked	No	15 c.c.	Peculiar condition felt to be psychic. Not sympathetic in origin
15	8-22-31	A. B.	M	63	Spondylitis	Pain in back and hip, ankylosis of hip	Rt. L. 1-2-3-4	0	No	20 c.c.	Unsuccessful injection, to be repeated
16	9-18-31	E. S.	M	82	Spinal cord sclerosis	Severe pain in both legs, atrophy	Lt. L. 1-2-3-4	4°C.	0	20 c.c.	Fair vascular result. No relief of pain. Therefore not sympathetic in origin

TABLE II
ALCOHOL INJECTIONS FOR VASCULAR LESIONS

No	Date	Patient	Sex	Age	Diagnosis	Symptoms	Injection Level	Temperature Increase	Relief Pain	Alcohol	Results and Comments
1	2-18-31	D. R.	M	73	Arteriosclerosis	Pain rt. calf, cold foot	Rt. L. 1-2-3-4	+++	Yes	20 c.c.	Relief for 48 hours, then recurrence of pain. See next injection
	2-21-31	D. R.	M	73	Same	Same	Rt. L. 1-2-3	+++	Yes	20 c.c.	Complete relief of pain this time. Neuritis +++
2	3-18-31	A. G.	M	70	Arteriosclerotic gangrene	Pain and gangrene to ankle	Rt. L. 1-2-3-4	?	?	20 c.c.	Injection immediately before amputation below knee. Healed well, no pain. Neuritis 0
3	4-10-31	V. J.	M	58	Arteriosclerosis	Pain—trophic changes, absent pulsations	Lt. L. 1-2-3-4	8.5°C.	Yes	20 c.c.	No more pain, foot warm; amputation because of complete ankylosis
	5-20-31	V. J.	M	58	Same	Same	Rt. L. 1-2-3-4	10°C.	Yes	20 c.c.	Permanent relief of pain. Leg warm, of good color. Neuritis +++
4	4-10-31	J. M.	M	55	Arteriosclerosis Post-amputation toe drainage	Pain—draining gang. area. Cold, vessels not palpable	Rt. L. 1-2-3	++	Yes	15 c.c.	Pain gone. Draining area healed. Foot warm. Neuritis +++
5	4-18-31	H. E.	M	53	Arteriosclerosis or Buerger's disease	Pain—cold blue foot—weakness	Rt. L. 1-2-3-4	12°C.	Yes	20 c.c.	Pain gone. Foot warm, pink. Neuritis 0
	6-4-31	H. E.	M	53	Same	Same	Lt. L. 1-2-3	10°C.	Yes	20 c.c.	Same result. Neuritis +
6	4-22-31	S. M.	M	50	Arteriosclerosis or Buerger's disease	Cold foot. Pain and cramps when walking	Rt. L. 1-2-3-4	7°C.	Yes	20 c.c.	Complete relief for 5 months. Recurrence, to be re-injected
7	4-28-31	R. H.	M	57	Arteriosclerosis and C.N.S. Les	Pain and non-healing ulcers	Lt. L. 1-2-3-4	3°C.	Slight	20 c.c.	Somewhat improved condition, but ulcers probably due to lues. Neuritis 0
8	5-13-31	H. N.	M	46	Raynaud's with muscular atrophy	Cold, clammy cyanotic painful extremities	Rt. D. 1-2	6.7°C.	Yes	10 c.c.	Permanent warm, pink, painless hand. Neuritis +++
	6-4-31	H. N.	M	46	Same	Same in feet	Lt. L. 1-2-3	7°C.	Yes	15 c.c.	As above. Neuritis ++. No effect to date noted on atrophy
9	6-17-31	M. B.	M	73	Arteriosclerosis	Unable to walk for pain both legs. Feet always cold	Rt. L. 1-2-3-4	10°C.	Yes	20 c.c.	Immediate relief of pain; foot became warm. Neuritis ++
	6-24-31	M. B.	M	73	Same	Same	Lt. L. 1-2-3-4	8.5°C.	Yes	20 c.c.	Same result, able to walk after injection. No pain, feet warm. Neuritis 0
10	7-10-31	J. N.	M	68	Arteriosclerotic gangrene	Pain and gangrene of toes	Lt. L. 1-2-3-4	1.9°C.	0	20 c.c.	Amputation disclosed complete obliteration of all vessels
11	7-15-31	T. V.	M	67	Arteriosclerosis with gangrene	Recurrent pain and gangrene after Le Riche operation	Lt. L. 1-2-3-4	5.6°C.	Yes	20 c.c.	Pain gone. Gangrene healed rapidly. Neuritis
12	7-24-31	A. B.	M	35	Buerger's disease	Pain, cold foot, ulceration of ankle	Lt. L. 1-2-3-4	6°C.	Yes	20 c.c.	Pain gone, foot warm, ulcers healed. After 2 months recurrence. Operation advised

TABLE II (Continued)

No.	Date	Patient	Sex	Age	Diagnosis	Symptoms	Injection	Temperature Increase	Relief Pain	Alcohol	Results and Comments
13	9-5-31	H. T.	M	78	Arteriosclerosis with gangrene	Painful cold foot, beginning gangrene toes	Rt. L. 1-2-3-4	5.8°c.	Yes	20 c.c.	Pain gone, toes back to normal within 2 weeks. Neuritis ++
14	9-16-31	O. J.	M	56	Arteriosclerotic gangrene	Pain—gangrene of toe	Lt. L. 1-2-3-4	3°c.	Yes	20 c.c.	Gangrene cleaned up. Pain almost entirely gone
15	9-18-31	A. M.	M	58	Arteriosclerosis. Extensive gangrene entire foot	Severe pain gangrene up to ankle	Rt. L. 1-2-3-4	4°c.	No	20 c.c.	Alcohol injected as preamputation measure. Caused demarcation and edema disappeared. Good blood supply to stump
16	9-30-31	J. M.	M	50	Intermittent claudication	Pain from knee down when walking, cold feet	Rt. L. 1-2-3-4	12°c.	Yes	20 c.c.	Pain gone. Foot warm and dry. Neuritis o

lasting for forty-eight hours. This should rarely occur as procaine should always precede alcohol to determine by means of the cough reflex whether the pleura has been penetrated.

Cases have been reported of paralysis as a result of injecting alcohol intradurally or intramedullarly. This is impossible if the Lundy technique is used; penetration of pleura is also less common.

Sudden collapse with momentary cessation of either respiration or pulse or both has occurred, usually in the dorsal injection. This occurs just as the alcohol is being injected, for there seems to be a terrific shock associated with the injection of alcohol so close to the pleura even though the patient is under general anesthesia. Although only momentary, as a rule, in one case artificial respiration was necessary.

The Horner syndrome of necessity follows the dorsal injection of alcohol.

Duration of Results. This is the only uncertain factor in this type of treatment. We have noted continued vasodilatation present one year following injection; we have also noted its disappearance within one month. The duration seems to depend upon the proximity of the point of the needle to the sympathetic chain at the

time of injection. If a direct injection of the trunk and ganglia is made the result should be permanent, but this probably does not occur in a very large percentage of cases. In some cases, even where vasodilatation has apparently disappeared, pain has not recurred. We now have our first case in which reinjection is necessary: an arteriosclerotic reports recurrence of pain and is to come in for reinjection, after relief for a period of five months.

In the cases in which we have performed injection and operation on the same patient on opposite sides, the operated side invariably shows more evidence of vasodilatation after a lapse of two or three months, although relief of pain may be equal. For this reason we advocate operative measures in those cases where maximum blood supply is essential.

Alcohol Injection versus Surgical Removal. We have already indicated our opinion in the preceding paragraph. Injection will never replace surgery. It can always be used as a substitute for surgery when, for any reason, surgery is contraindicated.

In the dorsal region owing to the severity and duration of neuritis following injection, we feel that surgery is preferable,

TABLE III
ALCOHOL INJECTIONS IN ANGINA PECTORIS AND CHRONIC POLYARTHRITIS

No.	Date	Patient	Sex	Age	Diagnosis	Symptoms	Injection	Temperature Increase	Relief Pain	Alcohol	Results and Comments
1	2-20-31	W. M.	F	40	Polyarthritis deformans	Pain, deformity, marked limitation of motion	Rt. L. 1-2-3-4	+	Yes	20 c.c.	Marked relief of pain and increase in joint function. Progressive improvement. After 5 months recurrence of pain
	4-3-31	W. M.	F	40	Same	Same	Rt. D. 1-2-3	+	Yes	15 c.c.	Relief of pain, increase in function not as marked as on operated side. Both injections caused neuritis +++
2	4-7-31	A. B.	F	54	Polyarthritis deformans	Pain, deformity, limitation of joint motion	Rt. L. 1-2-3-4	9°c.	Yes	20 c.c.	Complete relief of pain. Marked increase of motion and temperature increase
	4-29-31	A. B.	F	54	Same	Same	Rt. D. 1-2-3	Marked	Yes	15 c.c.	As above, but not as permanent. Temperature increase gone in 3 months
	6-10-31	A. B.	F	54	Same	Same	Lt. L. 1-2-3-4	7.8°c.	Yes	20 c.c.	Pain relief only moderate in this instance. Temperature increase gone in 2½ months
3	6-10-31	L. S.	M	42	Polyarthritis deformans	Pain, deformity, limitation of motion	Rt. D. 1-2-3	+	Yes	15 c.c.	Relief of pain, increase in function. Temperature increase to date. Neuritis ++
	6-18-31	L. S.	M	42	Same	Same	Lt. L. 1-2-3-4	+	Yes	20 c.c.	As above, in both cases to date injection result comparable to surgical removal done on opposite side
4	4-21-31	F. B.	M	67	Angina pectoris coronary sclerosis	Severe pain, shortness of breath, cyanosis	Lt. D. 1 to 5	not measured	Yes	25 c.c.	No anginal pain since injection. Shortness of breath and cyanosis gone. Neuritis ++
5	6-12-31	T. M.	F	..	Angina pectoris	Severe anginal pain, confined to bed 6 months. Very short breath	Lt. D. 1 to 5	not measured	Yes	25 c.c.	No anginal pain. Able to be about. Neuritis +
6	7-29-31	M.	M	..	Angina pectoris	Severe pain on exertion, abdomen, chest and left arm	Lt. D. 1 to 5	not measured	Yes	25 c.c.	No anginal pain. General condition improved. Neuritis +++

and patients who have had both concur in this.

Alcohol injection can, however, be used in a wide variety of conditions in which

an operation of the magnitude of ganglionectomy would not be justified.

The injection is not without danger and should not be done by anyone not thor-

TABLE IV
ALCOHOL INJECTIONS—MISCELLANEOUS CONDITIONS

No.	Date	Patient	Sex	Age	Diagnosis	Symptoms	Injection-level	Temperature Increase	Relief Pain	Alcohol	Results and Comments
1	10-4-30	G. F.	M	30	Multiple sclerosis	Spasticity	Labat: L. lumbar	15°r.	....	15 c.c.	Marked increase in temperature. No effect on spasticity. Neuritis 0
2	12-10-30	M. M.	F	73	Trifacial neuralgia	Severe facial pain in all 3 divisions	Rt. D. 1-2 Labat	not measured	Yes	15 c.c.	Patient lost track of after 6 months, during which time she had no further pain
3	2-12-31	E. W.	F	33	Elephantiasis	Marked enlargement of leg following Kondoleon operation	Lt. L. 1-2-3-4	15°r.	....	20 c.c.	Leg remained warm for 2½ months. No effect on elephantiasis. Neuritis
4	3-14-31	M. S.	F	78	Atypical facial pain, coronary disease	Pain in face, neck, shoulder	Lt. inf. cerv. 1-2 D	not measured	Yes	15 c.c.	Facial pain entirely relieved. Neuritis so severe that could not determine about neck and shoulder pain. Died cardiac death in 2 months
5	3-17-31	L. R.	F	34	Spastic paraplegia. Chronic constipation	Both legs spastic, constipation since birth	Lt. L. 1-2-3-4	not measured	....	20 c.c.	Considerable reduction in spasticity of both legs. Constipation markedly improved. Neuritis ++
	3-24-31	L. R.	F	34	Same	Same	Rt. L. 1-2-3-4	not measured	....	20 c.c.	
6	4-29-31	N. B.	F	50	Diabetic neuritis	Severe pain in rt. leg	Rt. L. 1-2-3-4	++	Yes	20 c.c.	Pain relief to date. Has some pain relieved by sodium bicarbonate
7	6-1-31	G. D.	M	53	Epigastric pain and burning	Pain of unrecognized origin; thought possibly sympathetic	Lt. D. 6-12	not measured	No	35 c.c.	Following novocaine pain in epigastrium relieved. Requested alcohol injection of other side. After both sides injected pain was as severe as before. Neuritis +++
	6-3-31	G. D.	M	53	Same	Same	Rt. D. 6-11	not measured	No	30 c.c.	
8	7-22-31	E. C.	M	74	Diabetic neuritis, gangrene in toe, amputation stump	Severe pain and non-healing amputated toe stump	Lt. L. 1-2-3-4	3°c.	Yes	20 c.c.	Pain gone to date. Gangrene granulated in, healing rapidly, after removal of infected bone
9	8-19-31	H. H.	F	68	Indeterminate	Pain both legs. Thickening and hardening of skin. Large ulcer on leg	Rt. L. 1-2-3-4	++	Yes	20 c.c.	Immediate relief of pain. Ulcer healed completely within 4 weeks. Skin rapidly clearing up.
	8-26-31	H. H.	F	68	Same	Same	Lt. L. 1-2-3-4	None	No	...	Owing to deformity failed to strike sympathetics
	9-5-31	H. H.	F	68	Same	Same	Lt. L. 1-2-3-4	++	Yes	20 c.c.	Immediate relief of pain, progressive improvement in skin to date. See text

TABLE IV (Continued)

No.	Date	Patient	Sex	Age	Diagnosis	Symptoms	Injection-level	Temperature Increase	Relief Pain	Alcohol	Results and Comments
10	8-24-31	R. L.	F	35	Malignancy of pelvis	Right side, severe pain in hip and leg	Rt. L. 1-2-3-4	not measured	Partial	.....	Patient felt pain was diminished by novocaine. Alcohol injected; only partial relief of pain
11	9-10-31	G. B.	M	47	Pain and atrophy of rt. leg. Unknown origin	See diagnosis	Rt. L. 1-2-3-4	4°C.	Partial	20 c.c.	Patient felt pain relieved by novocaine. Alcohol injected. Too soon to evaluate but probably a failure. Neuritis +++
12	10-1-31	A. M.	F	24	Indeterminate; neuritis, left leg	Severe pain and burning in rt. leg, following spinal anesthetic. Cold clammy foot	Lt. L. 1-2-3-4	17.5°F.	Yes	20 c.c.	Novocaine warmed foot and relieved pain definitely, so alcohol was injected. Final result (?)
13	10-2-31	A. J.	F	28	Indeterminate; severe neuritis lt. arm and neck	Severe pain in left arm, neck and ear, following burn on hand 3 years ago	Lt. D. 1-2-3	7°C.	Yes	15 c.c.	Immediate relief of all pain in arm, neck and ear, with novocaine and alcohol same result severe neuritis from alcohol

oughly conversant with the technique, the anatomy, and the dangers.

SUMMARY

The most satisfactory diagnostic procedure for conditions affected by the sympathetic nervous system is the direct injection of procaine at the sympathetic nerves.

By means of these diagnostic injections it is possible to determine accurately whether or not therapeutic measures should be directed toward the sympathetic nervous system.

The two factors most frequently involved are pain and diminished blood supply. Diagnostic injection gives definite information as to relief of pain and what quantitative increase in vascularity may be obtained by therapeutic measures.

Alcohol injection of the sympathetic nerves is an established therapeutic measure. We have used it successfully in arteriosclerotic conditions, Buerger's disease, Raynaud's disease, chronic polyarthritis, trifacial neuralgia, atypical facial pains,

angina pectoris, trophic ulcers, neurotrophic skin lesions, diabetic neuritis, and other conditions.

Tables are presented including 64 diagnostic injections, 48 of which were followed by alcohol injection with uniformly good results.

Alcohol injection may be used as a substitute for surgical removal of sympathetic ganglia where the latter is not indicated.

Alcohol injection does not have the permanency of the operation and is therefore not indicated where permanent maximum blood supply is essential except where operation is definitely contraindicated.

Alcohol injection can be used more successfully than the LeRiche operation in all of the conditions for which this operation has been advocated.

Surgery or alcohol injection on the sympathetic nervous system should be preceded by diagnostic procaine injection. This diagnostic injection has taken guess work entirely out of the realm of sympathetic therapeutic measures.

[For References see p. 625.]

SOME THOUGHTS ON THE PROBLEM OF CANCER CONTROL*

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DURING the last quarter of a century, the subject of cancer control has been receiving an ever-increasing amount of attention, and in the last decade, it has taken first place in the discussions of medical societies throughout the world. Interest on the part of the laity has likewise been rapidly increasing, due in a measure, to the widespread propaganda of the numerous societies for the control of cancer, and also to the fact that the mortality of cancer has been steadily rising, especially during the last twenty-five years. A pioneer among these societies is the American Society for the Control of Cancer, and it is gratifying to note that this society in 1927 had little difficulty in raising the million-dollar endowment which it set out to do. Among the many proofs of this growing interest in the problem of cancer may be mentioned the International Lake Mohonk Conference held in 1926, and the International Cancer Conference held in London in 1928 under the auspices of the British Empire Cancer Committee. Both of these were attended by delegates from all over the world, and interesting and valuable papers were presented by the leading specialists in the field of clinical and laboratory cancer research. I had the privilege of being present at both of these conferences.

A careful review of the reports made on these two occasions leaves one in a very pessimistic frame of mind. No new light was thrown upon the fundamental problem, i.e., the etiology of cancer; and practically nothing new was offered in the way of more efficient methods of controlling cancer or of checking its steadily rising mortality.

A most important paper at the Lake Mohonk Conference was that of Ewing on "The Prevention of Cancer." In the opinion of Ewing, prevention plays a prominent rôle in the control of cancer. He stated there were many reasons for the current neglect of the prevention of cancer. Among the obstacles enumerated was, "the general assumption that cancer is the result of hereditary tendencies which express themselves in the so-called spontaneous outbreak of the disease." However, he did not believe that *heredity* could be dismissed from a practical consideration of the origin of cancer; and he approved of the public being advised that, when there is a strong tendency to cancer in the family, the other members take unusual precautions against the disease.

A far more serious obstacle he believed, was the widespread assumption of the parasitic theory of the origin of cancer. He stated:

If cancer is due to the action of an unknown microscopic, perhaps ultramicroscopic, universal parasite, then effectual prevention must await upon its discovery. At the present day, I have no hesitation in committing myself without reservation against this theory. With most general pathologists, I regard it as incompatible with the known facts about cancer. The assumption of a universal cancer parasite can be held only by those who assume in addition that cancer is a single disease, comparable to syphilis or tuberculosis. This assumption appears to be untenable. Cancer is not a single pathological entity, but a great group of diseases, of very varied origin and course.

And yet, Ewing admits that neoplastic reaction of tissue cells is comparable to

* Read before the Tri-State Medical Association, Memphis, Tenn., February, 1931.

inflammatory reaction, which latter, is due to a microbic cause.

According to Ewing, a rational basis for the prevention of cancer lies in the fact that the major forms of the disease are due to some form of chronic irritation. In closing, he pointed out that early diagnosis alone is not capable of accomplishing the desired reduction in the death rate; that the patient coming with an early diagnosis all too often fails completely of a cure. He states, "The experience of patients accomplishing a cure of early cancer is generally a severe one, while the fate of the failures is passed over in silence. The public knows these facts and therefore any plan of squarely meeting the problem of cancer control must eventually lean heavily upon cancer prevention."

While it may be possible to avoid or prevent a certain amount of chronic irritation, in the great majority of cases the chronic irritation which is supposed to be the exciting cause of the malignant tumor is associated with the occupation or routine activity of the individual, and cannot well be avoided unless one is able or willing to give up work or all physical activities and lead a life of leisure.

RESULTS OF SURGICAL TREATMENT OF CANCER

According to some statistics, it has been found possible to obtain from 30 to 50 per cent five-year recoveries in cancer of the breast by early operation, and 33 per cent five-year recoveries in cancer of the cervix by surgery and also by radiation. However the occasional results reported by a few surgeons of large experience and unusual skill fail to give a true picture of the actual average results following the surgical treatment of cancer. This was recognized by Gibson.¹ His unique report of 583 cases of malignant disease observed on the First Surgical (Cornell) Service of the New York Hospital, from February, 1913 to January 1, 1926, showed that of 437 patients operated upon, 308 had died; only 64 were known to be alive and free

from recurrence at the time of the report, and only 13 were alive for a period of five years after operation. According to Gibson: "No sadder report of the disheartening status of cancer surgery has come to our attention. It is however inevitable, dealing only with facts . . . Similar research emanating from other institutions would doubtless furnish surprises. We have been living in a fool's paradise."

One month after the publication of Gibson's paper, the end-results of treatment by operation and radiation in 376 cases of cancer of the mouth, observed at the Massachusetts General and Collis P. Huntington Memorial Hospital during the years 1918, 1919 and 1920, were brought out by Simmons.² In brief, only 20 patients were well for a period of three years; 16 of these were treated by surgery, and 4 by radiation. In the surgical cases only was the diagnosis confirmed by microscopical examination. Of 108 cases in which the regional glands were involved at the time the treatment was begun, there were no cures.

Shore,³ has given us one of the most complete and valuable set of statistics dealing with the operability of cancer. This paper is based upon a study of 1000 cases of cancer observed at St. Luke's Hospital, New York City, from July 1923 to January 1927.

1. 62 or 6.2 per cent refused admission as hopeless.
2. 306 or 30.6 per cent admitted but not regarded as suitable for operative surgery.
3. 632, or 63.2 per cent admitted for treatment.

Of the 320 patients operated upon 26 or 8.11 per cent died. Only 29.4 per cent left the hospital with an assurance that the malignant process had been removed. Shore observes: "These are indeed discouraging figures in the surgical treatment of cancer."

The conclusion is that 68 per cent of the 1000 patients were found inoperable when they reached the hospital. Many more of the remaining group died of recurrence.

Wood, in a later paper, based on a study of 748 cases of cancer, found only 135, or 21.8 per cent mechanically removable at time of observation.

These statistics represent the results obtained by a few men of unusual skill and experience. The average results throughout the country give an even more gloomy picture, and it is upon the average results that the opinion of the laity is based. Realizing this, the reason for their pessimism becomes apparent. In spite of all the recent propaganda urging the patient to consult a doctor on the slightest suspicion of a cancer, it has been found that in many cases, even of the breast or tongue, where early recognition would seem certain, the patient himself has not been aware of the existence of a cancer until it had involved the regional nodes.

The most discouraging fact in connection with cancer control is, that more than one-half of all cases of cancer occur within the abdominal cavity; and in this large group of cases, the disease has usually progressed too far before the diagnosis is made to justify much hope of curing it by any known method. While a considerable number of cases of cancer of the stomach have been cured by surgery performed by men who have devoted years to the perfection of their technique in this field, the fact remains that the vast majority of patients with cancer of the stomach die of the disease in spite of any treatment they are able to obtain. The best statistics do not show more than 2½ per cent of five-year cures in cancer of the stomach. The same is true of cancer of the liver and intestines. Therefore, we see that practically one-half of all patients with intra-abdominal cancer are destined to die of the disease in spite of any improvement in diagnosis and treatment.

The most discouraging feature about cancer, is its steadily rising mortality, which, according to Hoffman, is apparently universal. In 1885 the recorded cancer death-rate of Scotland was only 32 per 100,000, increasing to 41 by 1865 and to

48 by 1875. In other words, during the twenty years intervening, the cancer deaths increased exactly 50 per cent. The rate increased to 57 by 1885 and during the next ten years to 72, by 1895. The relative rise in the rate during these twenty years was, therefore, again exactly 50 per cent. By 1905 the rate had increased to 91 and by 1915 it had reached 111, or an actual increase in twenty years of about 39 per 100,000, or 54 per cent of the rate at the beginning of the next period. During the five years following, the rate increased to 119 and during the last three years, ending with 1923, to 130. This, in other words, is the highest rate ever reported in the history of Scotland. Thus, in forty years, or between 1884 and 1923, the cancer rate has more than doubled, or, precisely, has increased from 56 to 130 per 100,000, equivalent to about 132 per cent. Hoffman has placed the increase in the cancer death-rate at about 100 per cent during the last forty years.

I would direct attention to some equally interesting statistics for the province of Ontario. According to the last registration report, the cancer rate of that province in 1914 was 69.6 per 100,000, which by 1918 had increased to 75.5 and by 1923 to 90. Cancer of the buccal cavity underwent slight changes, but there was a material increase in cancer of the stomach, from 22.8 in 1914 to 31.0 in 1923. Still more suggestive is the increase in cancer of the peritoneum and the intestines: from 9.8 in 1914 to 14.1 in 1923. Cancer of the female generative organs increased from 5.2 in 1914 to a rate of 9.4 in 1923. Cancer of the breast, which is certainly an easily diagnosed portion of the body, increased from 4.5 in 1914 to 9.2 in 1923. Cancer of the skin also increased, from 0.99 in 1914 to 2.7 in 1923. Other cancers, including unspecified ones, have remained practically stationary, the rate in 1914 having been 20.5, while in 1923 the rate was 19.2. It is pointed out in the report that the total number of deaths from cancer in the

Province reached 2724 for 1923, or probably nearly 3000 for 1924. During the last decade the rate has increased at the rate of 20.4 per 100,000 of population. Comparing the mean rate of the last decade with that of the preceding decade, there has been a relative increase in the cancer death-rate of 31 per cent.

A study of the mortality statistics of the United States shows practically the same steady and marked increase in the death-rate from cancer in every state. Cancer has now reached second place among the causes of death and is rapidly approaching first place.

Before the Senatorial Committee in 1930 Dr. Joseph C. Bloodgood said:

Twenty years ago cancer occupied eighth place among the principal causes of death in this country. Its ascendancy to second place presents a vivid picture of the steadily increasing devastation caused by the disease. Cancer now is responsible for 10 per cent of the deaths from all causes in this country.

This increase has taken place in spite of the educational campaign of the American Society for the Control of Cancer during the seventeen years of its existence, in spite of cancer weeks and cancer days, in spite of much publicity through the daily press and the magazines, in spite of an increasing amount of radium available for the treatment of cancer, in spite of the improvement in and the standardization of hospitals in this country, in spite of the immense improvement in medical teaching, in spite of the fact that a large number of people are enlightened and come earlier.

Therefore, if more than 100,000 die annually, there must be from 300,000 to 500,000 cases of cancer living in any one year, who have either received treatment or not. I am inclined to think that more than 50 per cent of them have reached the hopeless stage, notwithstanding treatment by surgery or radiation. I think that a consensus of most of the writers on this subject is that there are about 360,000 cases existent in the United States today.

All cancer students agree that the cause of cancer is undiscovered, except that chronic irritation can produce cancer in experimental animals and in the human being, but we do not know why it is so produced. All cancer

students agree that at present there is no specific cure for cancer outside of its removal by surgery or its treatment by radiation and we have demonstrated that the results of such treatment in late cases are less than 10 per cent and in the earliest cases have reached about 50 per cent; but in a large per cent of all cancers—at least 30—the disease is hopeless from the onset, in spite of surgery or radiation.

We have sufficient evidence to know that cancer will never be eradicated completely as the cause of death until we have discovered the cause of the disease and the preventative and curative treatment. No matter how enlightened the individual is or how early he seeks treatment after the first warning, certain types of cancer are inaccessible, or become hopeless before the first symptom is noticed. Or, the cancer cell is of such a type that it disseminates at once before surgical removal is possible, and it is not radio-sensitive which means that radiation does not kill the cancer cells. Just as we need more education, continuous, systematic and organized, we need more and better organized research.

Before the same committee Dr. James Ewing stated: "My own experience and general judgment as a pathologist relates to the proportion of cases of cancer that are now cured in the average good hospital service in this country, and I find that it is not more than ten per cent."

Moynihan, in the Hastings Lecture (*Lancet*, January 2, 1927) discusses cancer and how to fight it. He believes that the oft-repeated attempt to explain away the steadily rising mortality of cancer on the ground that (1) people live to a greater age now than formerly, and (2) that in earlier times there were more errors in diagnosis, has no foundation in fact. While he emphasizes the importance of the early diagnosis and the early surgical removal of cancer, he does not rest content with this alone. He would concentrate our attention upon two points, laying greater stress upon the second: (1) to make the very utmost of our present methods which are applicable to all cases of accessible growths; and (2) to undertake research so that we may discover the cause or causes of cancer and so be enabled to do something for the pre-

vention of the disease or for its cure by methods other than surgery.

The present methods of cancer control are based entirely on the theory that cancer is of intrinsic origin, that is, due to something inherent in the cell itself, and not to the influence of some extrinsic agent such as a microorganism.

The great majority of pathologists today are firm believers in the intrinsic origin of cancer. They dominate not only the laboratory field of cancer research, but the clinical field as well; and they are on record as deprecating the time and money spent in further research along the lines of a microparasitic origin of malignant tumors. As a matter of fact, very little time and money have been spent in research along the latter lines in recent years, for the simple reason that the directors of cancer research laboratories are so strongly opposed to the extrinsic theory that young men entering the field of cancer research hesitate to engage in a study so strongly condemned. Furthermore there has been a steady attempt to regard the question as closed and definitely settled. No field of medical research has ever been so completely under the influence of authority as the field of cancer research.

Tradition and authority are of great value in medicine as in any other science, but there comes a time when the investigator must forget the existence of both and concentrate his whole thought and energy upon the discovery of new facts; he must apply the principles of logic, both inductive and deductive, and endeavor to arrive at some definite conclusions. When these have been reached and they seem to be founded on indisputable facts, he should be willing to stand by them, irrespective of whether or not they conflict with opinions handed down by tradition and supported by authority.

Ewing's assumption that "If cancer is really caused by an unknown parasite, then prevention is not to be considered" does not seem to rest upon any logical basis. If we have found out by experience

that cancer is often the result of chronic irritation or of local trauma, it seems both logical and natural that we should take all possible steps to avoid these predisposing factors, quite irrespective of whether we do or do not know the real or underlying cause of the disease. One might as well argue that we should not have made any attempt to improve the hygienic conditions in the prevention of tuberculosis before the germ was discovered, although it was well known that persons living under very bad hygienic conditions were more likely to develop the disease. All the known methods of preventing cancer and all the improved methods of treating it should be carried out while we are making most strenuous efforts to discover the cause of the disease. I believe it is a mistake to discourage investigation along the lines that offer the most hope of ever gaining control of the disease, and decidedly discouraging is the statement from a recent leaflet of the American Society for the Control of Cancer:

If cancer is really due to an unknown parasite, then prevention is not to be considered; and we are not much better off than the ancient Egyptians, since we may at any time be stung to death by the hobgoblin parasite in its own mysterious way. The distressing difference in favor of the Egyptians is that they were beautifully embalmed like Tut-Ankhamen, and we are not.

Those of us who still firmly believe that cancer is due to some extrinsic cause will not be seriously disturbed by the substitution of ridicule for argument; but such statements coming from one of the most brilliant workers in the field of cancer research, cannot fail to discourage investigations along these lines.

In the *Annals of Internal Medicine*, May, 1930 (reprinted in the *Journal American Medicine Association*, June 7, 1930) an editorial writer (Warthin) on "Cancer Cures" makes a most unpromising attack upon the germ theory of cancer. While in his opinion there was some reason for entertaining the idea that

cancer might be of an infectious nature in the latter part of the last century, he states that by the end of the first decade of the present century experimental work on animals together with the fuller bacteriologic and pathologic studies of neoplasms "had convinced us that cancer is not an infectious disease; that no specific agent exists for the production of cancer." He claims:

Mistaken conceptions regarding certain infectious growths in the lower animals, particularly the so-called Rous chicken sarcoma, have been in part responsible for the persistence of such views. By many workers the chicken sarcoma is regarded as an infectious granuloma and not comparable to the true neoplasms in man. Furthermore, there exists today absolutely no proof that infection plays any specific part in the production of neoplasms; and when once the public mind has become cognizant of the fact that cancer has no infectious etiology, much will have been accomplished to prevent patients from falling victims to cancer cures.

While this writer brushes aside as of little importance the vast amount of research work done during the past twenty years on filterable fowl tumors on the assumption that these tumors are not infectious granulomata but are comparable to true neoplasms in man, it is curious that Murray, the Director of the Imperial Cancer Research Fund, regards these tumors as by far the most promising field in cancer research today. In his opinion these tumors now have been proved to be true neoplasms comparable to malignant tumors in mammals. A large part of the ninth scientific report of the Imperial Cancer Research Fund is devoted to further studies of the filterable fowl tumors.

Furthermore, the etiology of the filterable fowl tumors still occupies the first place in the cancer research work of the Rockefeller Institute, carried on by Murphy and his co-workers.

If it is true that these tumors are probably due to a living agent, it might be wiser to be a little less positive than was the writer of the editorial referred to, that

cancer in man cannot possibly be due to a similar living agent.

That the filterable fowl tumors are true malignant tumors and not infectious granulomata as claimed by the editorial writer in the *Annals of Internal Medicine*, is proved by the fact (as shown by Murray) that metastases in other organs, e.g., the liver or lungs, are always made up of cells corresponding to the type of cell found in the primary tumor, exactly as occurs in human cancer.

These tumors are now recognized in all the important Cancer Research laboratories of the world as true tumors and not infectious granulomata.

Let us study for a moment the main points in favor of the microbic origin of cancer:

1. The close resemblance of certain cases of cancer to other diseases of known microbic origin, for example, tuberculosis and syphilis.

2. The frequency with which there is both a local and general rise in temperature in cases of malignant tumor. This is especially true of endothelioma of bone and other types of cancer with rapid generalization, in which the general temperature often rises to 103–104°F.

3. The difficulty in distinguishing tuberculosis from sarcoma and chronic osteomyelitis, or osteitis from endothelial myeloma, either by the clinical evidence or, in some cases, even by a study of the histological appearance. In a few cases it is impossible for the most experienced pathologist to differentiate these conditions.

4. Single antecedent trauma is now generally conceded to be an important causative factor in malignant tumors, especially bone sarcoma. No satisfactory explanation of the influence of trauma has ever been offered except on the assumption that the malignant tumor was due to some microorganism. Granting this, the explanation is easy. We have an exact parallel in cases of osteomyelitis as well as tuberculosis of bone, following local trauma.

5. The antagonistic action of the streptococcus of erysipelas, and the toxins of erysipelas and *Bacillus prodigiosus*, upon various types of malignant tumors, is difficult to explain except on the theory that malignant tumors themselves are caused by some microorganism.

6. The remarkable variation in the geographical distribution of cancer. The most recent illustration of this may be found in the Westmoreland County Survey.¹²

Ewing and many other pathologists have stated that cancer is not a single disease, but a group comprising a large number of separate and distinct diseases, and in order to assume a microbic cause one must assume a large number of different microorganisms.

This assumption is by no means necessary. Sir Charles Ballance, at a meeting of the American Surgical Association twenty-five years ago, stated that he was firmly convinced not only that malignant tumors were due to some microorganism, but further that it would probably be shown that the same microorganism, under different conditions, gave rise to the different types of cancer.

Erwin Smith proved this to be true as regards malignant tumors in plants. By making superficial injections he produced epithelioma; by deep injections, a sarcoma; and by injecting a latent bud he produced a teratoma.

In a series of experiments recently carried out at the Laboratory of the Hospital for the Ruptured and Crippled by Dr. Richard F. Berg, using the dried virus of the filterable endothelioma fowl tumors, kindly furnished me by W. E. Gye, of London, found it possible to produce 5 different varieties of bone sarcoma, by injecting the virus into the marrow of the tibia of very young Rhode Island red chicks, one to two weeks old. These tumors correspond very closely to the several types of bone sarcoma in man.

The filterable fowl tumors, which are now almost universally accepted as true

neoplasms, comparable to malignant tumors in man, are believed, by the majority of investigators, to be due to some microorganism or living agent, although up to the present time it has never been isolated.

Conner, of San Francisco, had previously been able to produce endothelial myeloma by the same dried virus. Our five varieties corresponded exactly with the different varieties of bone sarcoma in man.

During the past year further experiments with this virus and with the tumors produced by it have been carried on by Dr. J. E. Sullivan (Dr. Berg's successor to the Gibney Memorial Fellowship, the Hospital for Ruptured and Crippled) and myself. These experiments I believe offer convincing evidence that these tumors are caused by a living agent. The full results will be published in the near future.

It would be possible to explain the different types of malignant disease in two ways:

1. The microorganism attacks a particular cell which, by reason of some specific factor, e.g., local trauma, chronic irritation or some chemical changes in the body fluids, offers a lowered resistance to the microorganism. By reason of this lowered resistance, the organism gains a foothold or finds a favorable soil for development, and thus begins the early stages of a malignant tumor. The microorganism enters the cell itself, becoming an intracellular parasite which by its constant irritation, stimulates the cell to growth and division. This growth is naturally made up of the multiplication of the cell in which the organism first enters, and this very naturally accounts for the remarkable fact that the metastases of a malignant tumor always correspond morphologically with the type of cell of the primary tumor. This has been one of the main arguments of the pathologists against the parasitic theory, but if we assume that we are dealing with an intracellular parasite, then the difficulty is at once overcome.

2. We may suppose that instead of a single strain there may be a number of strains of this unknown microorganism, closely related and, perhaps, indistinguishable under the microscope or by variations in the manner of growth upon culture media, which strains may produce different types of tumors.

Personally I am inclined to believe in a single microorganism possessing different degrees of virulence, which, having gained access to the blood of a healthy individual, remains latent until the natural resistance of the cells has been lowered in some local area by some special factor, e.g., local trauma, chronic irritation or chemical changes in the body fluids, furnishing the organism with a favorable soil for its development.

In addition, there may be some inherent or inherited susceptibility of the cells of a certain individual, or an unusual lack of resistance that may account for the varying degrees of what we call malignancy, without assuming a great change in the virulence of the microorganism.

What determines the type of the tumor may not be the germ but the soil or some inherent factor in the cell itself which attracts the organism to one type of cell in one individual and to another type in another individual. If the Rous sarcoma virus is injected into the blood of a susceptible fowl, no tumor develops. Not until an injection is made into areas in which connective tissue is present and a connective tissue reaction is produced, is it possible to produce new tumors. The Rous sarcoma is a spindle cell sarcoma.

The theory that cancer is due to some infectious or microbic cause received great impetus and support by the discovery of the filterable fowl tumors by Fujinami of Japan and Peyton Rous of the Rockefeller Institute (1910). It was found that these tumors could not only be produced by living transplants, as had been done in rat sarcoma and mouse carcinoma, but, by a cell-free filtrate. Then for a time an attempt was made to explain these tumors

as not being true neoplasms but similar to the so-called infectious granulomata. The virus itself has been studied in many laboratories, and various opinions have been held as to its true nature, one group of investigators, the larger, believing it to be a living agent, and another, a so-called enzyme or a chemical agent. The remarkable work of Gye of London in July, 1925, gave a new impetus to the opinion that cancer is due to a microbic cause, and the London *Lancet* gave his address a four-page editorial and intimated that at last the age-long problem of the cause of cancer had been solved.

Gye, basing his views upon a long and elaborate study of the Rous sarcoma, evolved the theory that cancer (malignant tumors in general) is not due to a single cause but to a dual cause. He believed: (1) that the Rous sarcoma tumor was due to a "living agent" which had not yet been isolated; (2) that this living agent alone could not produce malignant tumors, but required some other agent, which he called a *specific factor*, to produce the disease. His experiments seemed to prove the truth of this brilliant theory. He first rendered inert the active virus of the Rous sarcoma by chloroform or some antiseptic, until it could no longer produce any tumors on inoculation. Then by adding some one of several substances to this inert material, it once more became active and produced the Rous tumor on inoculation. This discovery was regarded at first as epoch-making, and seemed to go far toward solving the age-long problem of the cause of cancer; but, unfortunately, no one was able to repeat these experiments; and the most rational explanation would seem to be that the living virus was not entirely destroyed by the chloroform and that the addition of the *specific factor* simply helped to revive the inactive but not entirely dead virus, and rendered it capable of producing typical tumors.

Gye's⁴ theory differs but little from my own in a general way. According to my theory⁵ there is a dual cause: (1) the living

agent which may be widely disseminated and is often present in the tissues or in the circulation of many individuals but doing no harm; (2) Some other factor, not so highly specific as Gye's, for example, local trauma, chronic irritation, or some chemical change in the body fluid, that damages some local area thereby causing a tissue reaction or a favorable soil for the organism to gain a foothold; and thus the beginning of a malignant tumor.

Hereditary susceptibility is doubtless an additional factor in many cases. It means that certain individuals have inherited tissues or cells that are less resistant to the cancer organism when exposed to it.

My theory does not depend on the success or failure of a series of laboratory experiments such as Gye described. It has numerous clinical facts to support it. Furthermore, recent laboratory investigations furnish evidence in its favor.

Cramer, in the ninth Scientific Report on the Investigations of the Imperial Cancer Research Fund, reports a series of experiments in which he was able to transmit three strains of mouse sarcoma and Rous sarcoma without the presence of living cells. While numerous experiments along these lines have been made in the past, all seemed to prove that the transmission of mammalian neoplasm depended on living cells. Three different tumor strains were used by Cramer in his experiments: (1) rat sarcoma (2) different strains of mouse sarcoma, and (3) mouse carcinoma. The mouse carcinoma gave negative results.

These experiments would seem to place neoplasms in mammals measurably nearer, if not in the same class as the filterable sarcomas of Rous and Murray.

Among the clinical facts that furnish evidence in favor of the theory that malignant tumors in man are due to a microorganism or an infectious virus of some kind, the most important and convincing is the case reported by Lecène and Lacassagne.⁶ Here a medical student, while attempting to aspirate a collection of lymph from under the scar of an ampu-

tated breast (removed for cancer eleven days previously) pricked the palm of his left hand, at the same time discharging a small quantity of the liquid that was in the syringe. Three-quarters of an hour later the wound was cauterized with a galvanic current. The accident was forgotten until two years later when he began to have diffuse pain in the same hand. Shortly after he noticed a bosselated swelling at the exact site of the previous puncture. One month later an enlarged gland, the size of a nut, appeared in the axilla. This gland was removed and was thought to be tuberculous, although no evidence of the disease was found. Four months later the skin of the hand became invaded and ulcerated. One month later the tumor was excised under ether anesthesia. It recurred promptly and showed unmistakable evidence of being a malignant tumor. About five weeks later, four nodules appeared in the skin of the forearm; and a week later, disarticulation of the arm at the shoulder was performed. A careful histological examination of all the nodules and tissue removed at the various operations showed the same general structure. A diagnosis of spindle cell sarcoma was made.

Lecène and Lacassagne, after discussing various hypotheses expressed their conviction that:

The transmission of cancer is accomplished by the inoculation of a virus analogous to the filterable virus admitted by Gye, possibly of an infectious principle analogous to that admitted by Carrel. The change in the histology of the type of the tumor is entirely "reconcilable" with this hypothesis.*

In my own early experience I recall a case that points to the possibility of a lymphosarcoma of the axilla having been caused by a microorganism introduced in the finger by the prick of a thorn. A young

* In our experimental production of bone sarcoma in young chickens, at the laboratory of the Hospital for Ruptured and Crippled, Dr. Richard Berg, by injections of the virus of the endothelial fowl sarcoma was able to produce not only several varieties of sarcoma but, in two cases, typical carcinoma.

woman while picking roses, stuck a thorn into her index finger. Two or three weeks later, a swelling developed in the axilla of the same side, and grew rapidly. I removed it by operation and it proved to be a round cell sarcoma. It recurred promptly and finally caused death by general dissemination. I was greatly impressed at the time of a causal relationship between the wound of the finger and the rapid development of the malignant tumor in an axillary gland of the same side. I still believe that a micro-organism was introduced into the circulation by the thorn-wound of the finger and that it found in the gland of the axilla a favorable soil for development, causing the malignant tumor that proved fatal in less than a year.

Relative to the Part Played by Trauma. If we inject the active virus of a cell-free filtrate of the Rous sarcoma intravenously into an animal, no tumor develops. On the other hand, Pentimalli⁷ has shown that in a fowl bearing filterable sarcoma No. 1, a new tumor can be started by applying trauma to some other part of its body. The only explanation of this that can be offered is, that the trauma produced the connective tissue reaction that is essential to the development of a Rous tumor.

This experiment has a very important bearing on the question of trauma as a causative factor in the development of malignant tumors in man. Also it seems to furnish a striking analogy to the experimental production of osteomyelitis in rabbits. It has been found that a sharp blow to the tibia of a rabbit produces nothing unusual; but if the animal is first inoculated intravenously with a small quantity of *Staphylococcus aureus* and then struck a blow on the tibia, an acute osteomyelitis will develop. In other words, the local trauma furnishes the tissue reaction or soil favorable for the localization of the germ which is present in the circulation but quite harmless until the local resistance of the tissues has been lowered. If this theory is correct, then we have for the first time a rational and scientific explanation of

how trauma can be a causative factor in the development of malignant tumors.

One of the most recent and strongest arguments in favor of the microbic origin of malignant tumors, is found in the monograph of Prof. Léon Bouveret⁸ of Lyon, France. In addition to the clinical evidence in favor of the theory, he believes the most important and most conclusive evidence is found in the inhibitory, and often curative, influence of the streptococcus of erysipelas upon malignant tumors. This influence, recognized as far back as the time of Hippocrates and reported in a gradually increasing number of cases, is indisputable. Bouveret reports some personal cases and refers to others in French literature. He has carefully examined the various explanations of the curative effect of erysipelas on cancer, and can find only one that is at all satisfactory, i.e., that malignant tumors, themselves, are caused by some strain of streptococcus, and that the curative action of the erysipelas is brought about by antibodies in the blood. This is the explanation that I offered in my first paper 1893 in which I reported the results of treatment of 12 cases of inoperable cancer with the living cultures of the streptococcus of erysipelas; and I have continued to hold this opinion ever since. I would not go so far as Bouveret in assuming that the causative agent of cancer is a strain of streptococcus of erysipelas. I do not believe it essential to assume such a high degree of specificity that it could be acted on only by the same, or a strain of the same organism. We know that the tumors of leprosy have been caused to disappear by a combination of the toxins (vaccines) of the tubercle bacillus and the *Bacillus pyocyaneus*, quite as rapidly and completely as by a combination of the *B. leprosy* and *B. pyocyaneus*. The fact that we have been able to cause in a considerable number of cases the total disappearance of malignant tumors of practically all types by the mixed toxins of erysipelas and *B. prodigiosus* (which I began using in 1892) proves that heterogenous toxins may have the same

curative action as the autogenous. I would leave open the question as to the type of organisms that is the causative agent of malignant tumors; but that such tumors are caused by some living extrinsic agent, I believe, with Bouveret, that this action of the erysipelas furnishes the strongest kind of proof. Bouveret states:

"It is a fact generally admitted without dispute, that an acute febrile malady may cause a malignant tumor to regress." He believes it still remains to interpret this fact under the influence of diverse febrile conditions: a sarcoma, a lymphoma, and an epithelioma undergo a certain reduction in size. But, he adds, there is found a fairly pronounced regression that may occasionally go on to complete disappearance of the tumor. One finds this among the published cases only in those associated with an attack of erysipelas. To this general rule, Bouveret has found in his researches only two exceptions. Riffel⁹ has seen cases of cancer of the face and of the stomach, whose evolution was suspended by an attack of intercurrent variola. In one case of Kutzner,¹⁰ an attack of pneumonia caused a regression of a cancerous neoplasm. I have had a case of sarcoma of the tonsil nearly disappear after an attack of pneumonia, but it promptly recurred and proved fatal within a few months. There can be no doubt that the influence of erysipelas upon malignant tumors is much more powerful than any other febrile disease. Bouveret states that he has never noted regression following attacks of "la grippe," typhoid fever, eruption fevers, or septicemia. On careful inquiry in two hospitals for incurable cancer, he found no history of a case of cancer showing notable regression following intercurrent febrile disease such as bronchopneumonia, although there were many examples of such association. Bouveret asks: "Why is the influence of the erysipelas so preponderating?" and he adds, "Is it not permitted to presume that there exists some relation between the erysipelas and the cancer?" In other words, may not malignant tumors

themselves be caused by some microorganism, possibly by some strain of streptococcus closely allied to the streptococcus of erysipelas?

Bouveret has given the most careful study and discussion of the explanation of the regressive action of erysipelas upon malignant tumors that has ever been published, and a brief review of this argument should prove of interest. He points out that the explanation that has usually been accepted in the past, and the one that for the most part obtains today, is, that of "hyperthermie" or high temperature. This is the explanation that is offered by Willy Meyer in his recently published book on "Cancer."¹¹ It is one, however, which, at the time of my early experiments with inoculations of living cultures of erysipelas (1891-1892) I stated could not satisfactorily account for the inhibitory and often curative influence of an attack of erysipelas. The theory that I offered as the only one that could rationally explain this action, was: that malignant tumors themselves are due to some microorganism; and that the antagonistic and inhibitive action of the erysipelas streptococcus is due to certain changes in the blood serum brought about by antibodies which destroy the causative agent of the tumor, and that later, the degenerating tumor is either absorbed or undergoes extensive necrosis requiring incision and evacuation.

Bouveret, in agreeing with my early explanation, offers the argument that, if fever were the true, efficient and only cause of the marked regression of a malignant neoplasm, such regression would always follow an attack of erysipelas, especially in cases associated with a severe attack of erysipelas with unusually high temperature. As a matter of fact, he states that the very severe attack with high fever does not generally produce the most marked regression.

Again, if high temperature alone were the sole cause, then all febrile diseases associated with high temperature and also with malignant tumors, should show

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marked regression. Such we know is not the case. Clinical observation shows, without any question, that the greatest number of cases of regression are associated with erysipelas alone.

I do not agree with Bouveret that the most marked regressions are not associated with the more severe attacks of erysipelas. In my experience I have found that, as a general rule, the more severe the attack of erysipelas, the more marked the regression, but this I would by no means attribute to the higher temperature but to the production of antibodies in greater numbers and of higher antagonistic power. Bouveret states:

Erysipelas has the power of curing rebellious ulcers, lupus or syphilis. Is fever the exclusive agent of these cures? These old ulcers have not healed because they are the seat of a chronic, tenacious, microbic infection nor can it be the fever of the erysipelas that destroys the microbes of these infectious processes.

Borrel has made a study of the effect of fever upon pathogenic microbes: "The fever has a salutary significance, not because the microbes suffer from the elevation of temperature, but because it seems to destroy the processes of defense."

Duclaux¹¹ gives, after the work of Sternberg, the temperature necessary to destroy pathogenic bacteria. The staphylococcus dies at a temperature of 62°C. and the streptococcus at 54°C. Hence it is readily seen that the temperature of erysipelas, 39° to 40°C., falls far short of the degree necessary to destroy the microorganisms present in these old ulcers. Bouveret concludes that it is not the fever then that cures these rebellious, old, tuberculous or syphilitic ulcers, but some other mode of action. Why cannot this other mode of action, or agent, accordingly, cause a regression of malignant tumors?

If, then, the fever is not the essential cause of the regression, what is the cause? It must be the infectious state or infectious nature of the erysipelas. How does it act? The organism tries to defend itself

against the erysipelas infection. The general defense of the organism against an attack of erysipelas is assured, not only by the phagocytes, but also by the antibodies in the blood, antibodies which reduce or suppress the virulence of the streptococcus and neutralize the toxins it has produced.

Although Borrel in 1908 found that a transplanted rat sarcoma when subjected to a temperature of 37°C. for twenty-four hours lost its virulence, Haaland (Con-tamin Le Cancer Experimental, p. 130) studied the effect of heat upon mixed tumors, epithelioma and sarcoma, and found that a temperature of 44°C. for twenty-five minutes did not destroy the virulence of the sarcomatous cells. Fujinami and Inamaoto (Ménétrier: Le Cancer, p. 164) held that although it destroyed the sarcoma cells of filterable fowl tumors, it did not destroy the virulence of a fragment of tumor subjected to a temperature of 40° to 50°C. since it was found possible to inoculate successfully other fowls with the heated fragment. Doyen (Congress de Chirurgie, 1908) concluded from a series of researches, that the cancer cell was destroyed by a temperature of 56° to 58°C. Of course, such a temperature is vastly higher than that which occurs in an attack of erysipelas.

Once the truth of the parasitic theory of cancer is proven then a vast new field of scientific research is opened up, and this field holds out the promise of greater success in controlling the disease. We do not need to look for an immediate serum or vaccine that will effect a cure in a large proportion of malignant tumors that have already developed. Such a cure was looked for immediately on the discovery of the tubercle bacillus, and some of us remember the disappointment that followed Koch's failure to produce such a serum. We must expect the long period of observation and further investigation that followed the discovery of the tubercle bacillus. While no vaccine has been found that has proved of great value in the treatment of tuberculosis, knowledge of the habitat of the

tubercle bacillus and of its probable mode of access in the human body, has enabled us to develop preventative measures of great value, and now the mortality of tuberculosis is scarcely more than one-third of what it was before the germ was discovered. Observation revealed that the organism was found frequently in other animals especially in cows, and that many cases of tuberculosis in children resulted from the use of unpasteurized milk from infected cows. This discovery enabled us to institute preventative measures of great value.

In my own opinion, it would seem most probable that the microorganism supposed to be the cause of malignant tumors is very widely distributed; that practically everyone is exposed to it; that it is much more prevalent in certain countries and localities than in others, and that that is the chief reason why we find the wide variations in the incidence of cancer in different localities some of them in close proximity to one another. This theory is strongly supported by the recent survey of Westmorland County Survey.

In this connection, the investigation into the incidence, epidemiology, and ecology of cancer in Westmorland County, England,¹² is of interest. This survey, made under the auspices of the Westmorland Field Commission for Cancer Research, was carried out under the direction of Dr. Louis Sambon, whose cancer investigations in the American tropics, in Iceland, Holland, and Italy, are well known. This report states:

"In the first place, it was decided to discountenance all theories concerning causation, and to ignore, for the time being, all views based solely on clinical or pathological data. It seemed better to approach the disease as if totally unknown and collect only sheer facts . . .

Our investigations indicate very forcibly that we are confronted with a systemic infection characterized by long latency and exhibiting varied local manifestations, determined in type and site by the most diverse

physical, chemical, mechanical, or animate irritants. Insidious invasion, long quiescence, complexity of secondary factors, muteness of symptoms, and protean nature of manifestations are the peculiar features which have baffled inquiry so persistently.

Dr. Sambon believes that cancer is brought about by the activities of an exceedingly minute endocellular parasite strictly adapted to its specific cell host. He points to *Rickettsia*, the germ of typhus, which inhabits almost exclusively the endothelial cells of the capillaries, giving rise to marked defensive proliferation, the formation of intravascular overgrowths (Fraenkel's "nodules") and metastases. He looks upon the gross tumour—the actual cancer—as a late, often fatal, manifestation of the cancerous infection not unlike the gumma in tertiary syphilis. As in tuberculosis, so also in cancer, the specific germ appears to be universally prevalent and of wide zoological distribution.

Perhaps the most striking, the most interesting discovery our investigations have elicited is the great prevalence of all types of malignant and other neoplasms in animals. We have met with cancer in all kinds of wild and domestic animals, in pet animals, and in animals used as food. We might mention horse, cow, sheep, hog, cat, dog, hedgehog, rabbit, vole, rat, mouse, fowl, turkey, goose, owl, canary, and toad. Fowls of all varieties (Leghorns, Wyandottes, Plymouth Rocks, Bantams, Anconas, Rhode Island Reds in our series) are particularly liable, and we have noticed small outbreaks of the disease in certain poultry flocks similar to the cage epidemics of rats and mice mentioned by Borrel in France and by Gaylord in America. This unexpected, remarkable prevalence of the disease in all kinds of animals opens up a wide field of possibilities which we are already exploiting."

In his lectures at the London School of Hygiene and Tropical Medicine, and in his epidemiological papers, Dr. Sambon has repeatedly stressed the importance of a full knowledge of the zoological distribution of disease. Without a knowledge of the animal sources of infection it is not possible to understand, far less to control, outbreaks of disease in man. A memorable example is that of Russian artillery sent to destroy all the inhabitants of a plague-stricken border village in order to stay the epidemic. The unfortunate people were

sacrificed, but no one troubled about rats, and the disease soon spread like wildfire. Is it not known now that many cases of tuberculosis are not of human source, but, on examination, prove to be of either bovine or avian type?

When once the organism which proves to be the cause of human cancer is discovered we should at once make a careful study of our domestic animals, especially dogs, cats, fowl, pigeons, mice and rabbits and especially raw vegetables and sources of water supply. If the organism is found frequently in these animals, then the proper steps for lessening the chances of infection from such sources should be taken. It is quite possible that some of these animals might be carriers of the disease without themselves being affected by it. It is possible that the organism may be soil organism and enter the system through uncooked vegetables or raw fruit.

Finally it might be possible to produce a vaccine or serum that would have an inhibitory or curative action upon malignant tumors, or would be of great prophylactic value when used after operation or in connection with irradiation.

These are some of the numerous and attractive fields of investigation that would be immediately opened up once the germ has been discovered.

To those who are thoroughly convinced that cancer cannot be due to a microorganism, this may all seem scarcely more than a beautiful dream. To those who are still open-minded, I have tried to show that the microbic theory of cancer rests upon a solid foundation of clinical facts and is further supported by a large and steadily increasing amount of experimental and laboratory evidence especially in the field of filterable fowl tumors. It will require much further work and investigation before this theory can be definitely established; but when we consider that this is a matter of such vast moment to the million or more sufferers from cancer and to the still greater number who are certain to suffer from cancer in the years to come, we who are engaged in cancer research, both

clinical and laboratory, should feel stimulated to do our utmost to solve the problem of the cause of cancer. If the cause proves to be a specific living agent, as I believe it to be, then for the first time we shall have some satisfactory foundation for our hope of gaining control of the disease.

After you have listened to the arguments for and against the parasitic nature of cancer, you may feel yourself in the position of Rabbi Ben Ezra of Browning's poem:

Now, who shall arbitrate?
Ten men love what I hate,
Shun what I follow, slight what I receive;
Ten, who in ears and eyes
Match me; we all surmise,
They this thing, and I that: whom shall my
soul believe?

Unlike Rabbi Ben Ezra, I freely admit that the question of the etiology of cancer is not so nicely balanced, and that I belong to a small minority. Still one may remember that in medical science as well as in politics, minorities have a surprising way of becoming majorities in a very short time. What we need most is more facts rather than opinions.

CONCLUSIONS

1. Every means, including those already adopted by the American Society for the Control of Cancer, should be employed to encourage early recognition of malignant tumors as well as prompt and proper treatment of them. This entails not only continuous propaganda to persuade the patient to consult a physician as soon as a tumor is discovered, but, and what is more important, entails greater effort in educating physicians in the difficult field of the diagnosis of malignant tumors.

2. A considerable portion of the funds raised for cancer control should be expended in the field of collecting more facts, especially more accurate firsthand information as to the geographical distribution of cancer, and especially, data that may account for the wide variation in

incidence; in other words, surveys should be made similar to the one of the Westmorland County, England, conducted by Dr. Sambon in 1926-1928.

3. Little advance may be expected in the surgical treatment of cancer, but in the field of roentgen-ray and radium, I believe, that, with increasing knowledge of the action of these agents, and with improved technique, considerable advance may be anticipated. Radiation has already displaced surgery in certain fields, i.e., cancer of the skin, of the cervix, and oral cancer. It is rapidly becoming recognized that most cases of cancer can best be treated by a combination of surgery and radiation, rather than by the use of either alone.

4. A further study of the treatment of inoperable tumors, especially sarcoma, by the toxins of erysipelas and bacillus prodigiosus, should be carried out. It is found that a considerable number of these cases beyond hope from any other method of treatment can be cured by toxins, and that in many operable cases in which the toxins have been used as a prophylactic after operation a larger percentage of patients have remained well for five years; therefore this method should receive more general adoption.

5. A systematic attempt should be made to give the undergraduate medical student

much better clinical instruction in the early diagnosis of cancer than he has had in the past; and even more important is it to provide numerous centers where intensive post-graduate instruction may be obtained. Cancer departments should be organized in the larger general hospitals, to be in charge of men who have had wide experience in the diagnosis and treatment of cancer.

6. A number of so-called Cancer Institutes should be established in a few of the principal cities of the country, as recommended by Ewing at the meeting of the American College of Surgeons in October, 1929. Such institutes should have a large endowment to make them educational centers; they should be equipped to give the most approved methods of treatment; and they should contain research laboratories in which the whole field of cancer is studied.

7. The results of study by the various organizations and individuals working on the problem of cancer, including both the clinical and laboratory aspects, should be given wide publicity. At least every three to five years there should be an international cancer congress, bringing together the leading workers in cancer, and furnishing an opportunity for an interchange of ideas.

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HEMORRHOIDS—MEDICAL ASPECT*

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THE object of this paper is to present the subject of hemorrhoids as observed in the practice of a gastroenterologist. The material utilized for this study differs from that of the rectal surgeon in that very few patients complain of hemorrhoids as their only, or even chief, trouble. As a matter of fact, the piles are for the most part either incidentally mentioned in the history, or incidentally discovered in the course of the routine physical examination. Although extreme examples of the disease are not encountered in this type of practice, it is nevertheless possible that a study of this character can give a fair notion of the incidence, etiology and management of hemorrhoids as they occur in general practice, or in the population at large.

PATHOLOGY

A few well-known facts may be recapitulated. Piles are localized varices of the hemorrhoid plexus (i.e., they are a form of varicose veins). Internal hemorrhoids arise from the submucous plexuses above the anal sphincter; the external variety arise from the subcutaneous plexuses outside the sphincter. Bleeding is more common from internal than from external hemorrhoids, and ordinarily follows the passage of hard feces. An "attack of piles" is usually associated with thrombosis. The latter condition is essentially an acute thrombophlebitis which results from trauma plus infection from within or without the rectum. Another common complication is prolapse of simple or inflamed piles into or through the anal canal. This may result in possible strangulation or gangrene. As attacks of phlebitis recur, the vein wall thickens so that ultimately spon-

taneous obliteration of the pile may take place with the formation of a tab of cutaneous tissue.

INCIDENCE

General: The incidence of piles in our material was carefully investigated. A review of 1892 records showed that piles were present on physical examination in 499 cases, an incidence of 26.3 per cent. Of these 499 cases, 170 showed active hemorrhoids; the remaining 328 revealed the presence of tabs. In other words, we may assume from *physical examination* that whereas only 9 per cent of all cases show active hemorrhoids at any one time, an additional 17 per cent of patients present tabs as presumptive evidence of nature's cure of this condition.

On the other hand the incidence of hemorrhoids according to the patients' *history* seems considerably greater. Of 786 individuals who were interrogated on this point, 382, or over 48 per cent, admitted that they were suffering, or had at some time suffered from this condition.

Sex: A group of 656 cases which showed hemorrhoids either by history or physical examination, or by both methods, was analyzed as to sex incidence. Of these, 392, or 60 per cent, were females, and only 264, or 40 per cent, were males. As these figures reverse the usual sex incidence as handed down in the literature, a further analysis was made of 329 cases in which neither the history nor the physical examination revealed the presence of piles. In this group, 57 per cent were males and 43 per cent were females. Now, since our general material has been carefully checked as to sex incidence and since the variation between males and females does

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not exceed $2\frac{1}{2}$ per cent in groups of successive thousands, we feel safe in concluding that women suffer from piles more often than men in the proportion of 3 to 2.

Habitus: Of the 656 hemorrhoid-positive cases, 39 per cent were of the sthenic or stocky habitus and less than half as many (18 per cent) of the slim or asthenic build. This is to be contrasted with the general incidence of 27 per cent sthenics and 21 per cent asthenics in an unselected series of 3000 consecutive cases. Thus it appears that piles are associated with a stocky build almost twice as often as with the slim body habitus.

ETIOLOGY

Both predisposing and exciting factors operate in the production of piles. In regard to the former it has rightly been pointed out that the rectal veins possess no valves and that a considerable column of blood is supported by this vascular apparatus in the erect posture. A more important factor in this connection is the possibility that the venous plexuses in certain individuals are so rich and at the same time so weak that they congenitally predispose their owners to pile formation. This theory we believe, is somewhat supported by the greater incidence of hemorrhoids in sthenics mentioned previously, inasmuch as this build is known to be predisposed to certain other forms of herniation involving the digestive tract.

Among the exciting causes of piles, child-bearing and constipation are usually mentioned. We are inclined to agree as to the rôle played by the former factor, since many of the women questioned attributed their hemorrhoids to the birth of their children. As regards the influence of constipation, a special study was made because of the importance of this feature. To begin with, it is easy to be misled in this connection because constipation is a very common complaint. As a matter of fact, constipation was encountered in 54 per cent of our 656 hemorrhoid-positive

cases. However, further investigation revealed the fact that almost the same proportion, viz., 52 per cent, of our 329 hemorrhoid-negative cases were constipated. On the other hand, although 28 per cent of 500 constipated patients showed hemorrhoids on physical examination, it must be recalled that 26 per cent of our 1892 unselected cases showed hemorrhoids under the same conditions. To make these facts more impressive, an analysis of 500 patients suffering from colitis, a condition associated with diarrhea rather than with constipation, showed an incidence of hemorrhoids of 29 per cent, i.e., slightly greater, if anything, than the constipated group. In other words, it seems clear that constipation as such has little if any bearing on the production of hemorrhoids. This is in accordance with the significant statement by many patients that their piles do not bother them so much when their bowels are "tied up."

In sharp contrast with this are the facts concerning the cathartic habit. A review of a series of 405 cases of cathartic habit showed that hemorrhoids were present on examination in 144 or 38 per cent, an incidence higher than in any other group studied and almost half again as great as the general incidence of 26 per cent. We are therefore in absolute accord with the opinion that it is the abuse of cathartics, and for that matter, of enemas and irrigations as well, that constitutes the most important cause of hemorrhoids.

The mechanism involved appears to be the following: The rectal and anal mucosa is accustomed to the presence of formed feces, even when these are hard and expulsion difficult. A fissure at most results from the added effort. When however, undigested food products or fluid feces are rushed down, often containing an irritating cathartic as well, the mucosa becomes inflamed, congested and edematous, and protrudes more and more into or through the anal canal with each succeeding violent or explosive effort at defecation. Instead of the anal canal hold-

ing firm and moulding the fecal column as in the orderly process of normal defecation, the entire engorged mucosal ring at or above the internal sphincter assumes the rôle of a foreign body, undergoes partial extrusion, and thus increases venous stasis and promotes varicose formation. In short, it is the abnormal and frequent defecation resulting from artificial purgation that "brings down the piles," to adopt a common form of expression.

SYMPTOMS

It is unnecessary to elaborate on the clinical picture of hemorrhoids, as it is well known to everyone. Thrombosis is always characterized by pain, and prolapse by pain, tenesmus, itching and discharge. Bleeding is usually slight but in some cases long continued small blood losses may lead to a severe anemia of the aplastic type with signs of bone marrow exhaustion (poikilocytosis, absence of erythroblasts, diminution in neutrophile and eosinophile leucocytes). Two such instances were observed in our series.

In 1 or 2 cases seen in consultation for suspected intestinal obstruction, the condition seemed to be aggravated by the presence of large prolapsed hemorrhoids, possibly induced by violent attempts at restoring bowel function. As soon as the ectopic varices were replaced the passage of gas quickly relieved the distention.

DIAGNOSIS

For the diagnosis of hemorrhoids, the left lateroprone position is useful. External hemorrhoids and tags are readily seen on separating the buttocks. The recognition of internal hemorrhoids, however, is more difficult, and usually requires more special procedures. The finger introduced into the rectum may feel the soft irregularities or pouches just at or above the internal sphincter, but these may be empty of blood and not apparent except to the experienced palpator. A good technique for the demonstration of internal piles is to ask the patient to strain down as the

examining finger is withdrawn. This extrudes the piles into, or even out of, the anal canal. A similar demonstration can of course be made on the withdrawal of any of the endoscopic instruments.

The chief differential diagnosis of hemorrhoids is from fissure. This should offer no difficulty if the buttocks are well separated and the anus carefully inspected while the patient is straining.

There should be no question of differential diagnosis between cancer of the rectum and hemorrhoids. Mistakes are made only because the finger is not introduced into the rectum.

TREATMENT

The treatment of hemorrhoids involves two aspects, management of the underlying condition and care of the acute manifestation. As regards the former, the first and most important task is the restoration of normal colon function. This is equally essential whether the patient suffers from constipation or from diarrhea. Restoration of normal colon function implies the spontaneous production of one formed stool approximately once a day. The technique of conservative bowel management has been described in detail elsewhere, but it may be well to repeat here that the first step is the absolute withdrawal of irritating cathartics and of the usual forms of local treatment with enemas and irrigations. At the most, a small injection of oil may be used nightly for a time in the treatment of rectal constipation. For this purpose a hand syringe with a hard rubber tip is employed, never a soft rectal tube, as this causes much more trauma.

In general the patients do best on a bland diet with or without the addition of some substance such as agar or psyllium seeds, or barium sulphate to furnish bulk without undue irritation. Butter, cream and olive oil are particularly useful in thin people, whereas mineral oil or oil agar mixture is better for the obese.

The treatment of the local condition

may be described as conservative or radical. The majority of cases do well on the former. Perhaps the first requirement is the proper toilet of the anus. Cleanliness and gentleness are essential. To this end, the patient should be advised to move the bowels at home whenever possible so as to insure adequate facilities for proper care. After defecation the anal region should be washed with non-irritating (castile or ivory) soap and warm water, using absorbent cotton for the cleansing. The parts should be wiped gently or patted dry with cotton, not with paper, and finally powdered with talcum.

If hemorrhoids tend to prolapse, it is imperative to replace them *immediately* after each extrusion. It is remarkable how many people go about with prolapsed hemorrhoids when all that is needed is the proper advice and a finger cot and some lubricating jelly. By taking this simple precaution early, much trouble can be avoided. Should this prove impractical with the patient up and about, he should be put to bed. At bed time a tannic acid suppository should be inserted or a salve containing this drug applied to the anal region.

If there is much pain and edema, bed rest in the latero-prone position is indicated. The application to the anus of cold compresses soaked in witch hazel often suffices for relief. In more severe cases, a suppository containing anesthesin, 5 grains should be inserted before defecation and one of bismuth with or without adrenalin after each bowel movement and at bed time.

The results of this method of management, which I believe is that usually practiced by internists, are on the whole satisfactory. Relatively few of our cases have required surgical therapy.

On the other hand we believe surgery is clearly indicated in the following circumstances:

1. Hemorrhoids that are responsible for severe anemia. Here the operation should be preceded by blood transfusion.
2. Large hemorrhoids that are irreducible, or those that prolapse despite repeated reduction.

3. Ulcerating, gangrenous, or strangulated hemorrhoids.

4. Thrombosed hemorrhoids, although in patients unwilling to be operated on, and satisfied to bear the pain for two or three days longer, satisfactory results can be achieved by expectant treatment. In such cases, there is spontaneous absorption or expulsion of the blood clot.

The results of past surgical procedures as observed in our cases were investigated and may be summarized as follows:

Some form of radical operation was performed ninety times on 80 patients so that 12 per cent of our series of 656 hemorrhoid-positive patients were operated on. In addition, 4 patients were treated by injections and 2 by electrolysis. The injection cases did well, but one case treated by electrolysis resulted in failure.

The 90 surgical operations were followed by return of hemorrhoids in 22; by stricture in 8, by bad scar causing pain, spasm or bleeding in 3; by fistula in 1; and by paralysis of the sphincter in 1, a total of 35 cases or 40 per cent of questionable results in this series. In our opinion, however, the 22 cases showing return of hemorrhoids should not necessarily be charged up to poor surgery, since if our hypothesis that hemorrhoids are due to improper bowel hygiene is correct, there is no reason to expect permanent immunity from hemorrhoids if the original perpetuating factor remains active following the operation. After all, a surgeon operates for a lesion that exists, not for a lesion that may develop. Indeed, a radical excision of the entire ring of hemorrhoidal plexuses would result in a mutilation far worse than the original disorder. Accordingly, subtracting the 22 return cases, we have a net residue of 13 cases, or 14 per cent unqualified surgical failures.

It is hardly necessary to add that surgery in itself is not a complete treatment for piles, any more let us say, than it is a complete treatment for gastric ulcer. The original predisposition and the possibility of continued functional mismanagement still remain to invite the continued supervision of the experienced internist.

[For Summary see Author's Reprints.]

SURGICAL TREATMENT OF HEMORRHOIDS*

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SURGICAL treatment of hemorrhoids is not new. This operation has been routine for hundreds of years, but advances have been made in technique and in improved surgical principles. If we have not invented a new operation, we have at least been so fortunate as to learn what to avoid.

For some unknown reason a rough job seems to have had the right of way, whereas only the gentlest handling in this sensitive area should be allowed. Some of the archaic operative methods in vogue when I first became interested in rectal work still survive. I admit I was myself responsible for a form of torture by the invention of a plug, sufficiently large to make anyone's postoperative convalescence a hell on earth. With a powerful divulsion of the sphincter before operation, and the use of this plug afterwards, the operation was one never to be forgotten by the patient. They say the thumbscrew and the rack were playful in comparison. I have done all I could to counteract the misery I set forth, but it still seems to have a fascination for some operators, as news of it drifts back to me occasionally. I wish now to go on record that I condemn the plug I invented.

The operation as practiced today, under local anesthesia, is simple, effective and practically painless, and the patient is not detained in the hospital for more than four or five days.

I cannot too strongly condemn the old practice of divulsing the sphincter. It is crude; often followed by incontinence and invariably causes severe pain, hemorrhage into the muscles, and often a certain amount of dysfunction. If the internal and external sphincters are over-developed or spastic, it is safer to cut them posteriorly.

If incontinence should result a plastic operation will remedy this misfortune, but there is no remedy if incontinence follows divulsion.

Hemorrhoids are so often associated with other pathology that they should only be treated after a thorough proctoscopic examination satisfies the surgeon that there is no complication. About one-third of patients suffering from cancer have had a hemorrhoidal operation without this more serious condition being noted. This lack of discernment also applies to infection of the colon, diverticulitis, polyposis, and internal fistula, which Dr. Kantor has mentioned. Probably the infection was present before the operation and was not discovered. I can readily see the great importance of a thorough examination.

The frequency of hemorrhoids is such that the layman imagines all rectal troubles are hemorrhoids, and often the explanation given by the patient is accepted without trouble by the physician. Bush, in 1836, emphasized the fact that hemorrhoids were only too often associated with more serious ills. Ninety years later we give voice to the same warning.

Uncomplicated hemorrhoids give no symptoms except a vague feeling of fullness, and indefinite discomfort with some loss of blood. Severe bleeding occasionally occurs into the bowel but it is rare. On the other hand, repeated small hemorrhages result in a secondary anemia which is brought to the patient's attention by shortness of breath and general weakness. Of importance are the secondary and deferred symptoms, such as digestive disturbances, loss of appetite and constipation. Mental depression is almost always associated with pathology in the anal region, particularly in hemorrhoids. If

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these have existed for years with marked prolapse, loss of muscular tone is found, but one should be on guard not to confound this with a similar condition found in tabetics.

Today's operations are done nearly entirely under local anesthesia. Some men prefer spinal or general, but I like the local anesthetic better. Forty-eight hours before, a cathartic is given. In the evening an enema is given. In the early days I preferred the clamp and cautery to all other methods, but now I prefer the ligature. Perhaps for the man who operates infrequently, the clamp and cautery is safer. Surgeons have personal preferences, however, and by confining themselves to one method develop better technique. I achieve good results with ligature. All bleeding points, either in the hemorrhoidectomy or any other operation, should be clamped and tied and there is no fear of after-hemorrhages. The sphincter is cut posteriorly, and the wound packed with a little vaseline gauze. This remains in until after the bowels have moved which is generally forty-eight hours. My own practice is to give an enema of magnesium

sulphate, 1 oz. to a pint of water at a temperature of 112°F., the next day followed by a mild cathartic. The patient is then given an enema and the gauze removed. This should be done very gently. The wound must be irrigated after each movement.

The patient is kept under observation without any additional physical interference until the wound is healed. The operation is practically devoid of pain. Even with the first movement, which is usually dreaded by the patient, he is agreeably disappointed.

To summarize: in the past, hemorrhoidectomy was not alone attended by pain and discomfort, but often by incontinence. Bad news travels fast and leaves a lasting impression. The dread of this operation which is still inherent in the minds of the general public may be founded upon the results which attended the procedure as formerly performed. I am frequently asked: "Is there any danger of losing control if this operation is performed?" In the average surgeon's practice there is at present very little danger of this occurrence.



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* Continued from p. 604.

HEMORRHOIDECTOMY BY MEANS OF THE HIGH FREQUENCY CURRENT*

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A METHOD for the removal of hemorrhoids which is by no means ideal but is one that has given good results over a period of several years and in the hands of a large number of men, is the application of the high frequency current. The probability is that, with a growing acceptance of the value of these currents when employed surgically in other portions of the body and with a better understanding of the application of these currents, the method will come into more general use.

In the effort to learn of the experiences of men who have been using the high frequency current for the destruction of hemorrhoids, a questionnaire was sent out to which twenty-five relatively complete replies were received. This questionnaire with the summary of replies received, is as follows:

QUESTIONNAIRE ON THE USE OF THE HIGH FREQUENCY CURRENT (SURGICAL DIATHERMY) FOR THE DESTRUCTION OF HEMORRHOIDS

1. For how long a period of time have you been using this method? Varied from six months to ten years.
2. How many cases have you operated on in this manner? Totalled 3284.
3. Do you perform this operation in your office? 16 physicians.
hospital? 2 physicians.
both places? 7 physicians.
4. After the operation how long do you keep the patient in
(a) the office? Not at all, up to two hours.
(b) the hospital? Up to one week.
5. What instructions are given to the patient with reference to

- | | <i>before operation</i> | <i>after operation</i> |
|----------------|-------------------------|------------------------|
| (a) food? | light diet | light diet |
| (b) enema? | usually | |
| (c) cathartic? | not regularly | mineral oil |
6. What type of anesthesia do you use?
(a) in office? Local, novocaine, butyn, procaine, quinine urea hydrochloride.
(b) in hospital? Gas oxygen and ether.
 7. What, if any, measures do you use in conjunction with the employment of this technique? None specially.
 8. In what types of hemorrhoids do you use this method? Practically all types.
 9. Results:
(a) End-results? Good in every instance except one in which there is a report of stenosis in operation of first 5 cases.
(b) Immediate results
 1. pain after defecation? Usually little, occasionally moderate, lasts three to ten days, usually about four to seven days.
 2. pain other times? Rarely.
 3. bleeding, at time of operation? Very slight or none.
 4. bleeding after operation? Occasionally, slight.
 5. for how long a period of time is the patient usually incapacitated? From no time at all to one week, very rarely longer.
 10. Is your diathermy machine one of low voltage (up to 3500) or one of high voltage (beyond 3500)? Used about in equal proportion.
 11. What methods of applications of the high frequency currents for destruction of hemorrhoids do you employ?
(a) Electrocoagulation (bi-terminal, d'Arsonval type of current).
 1. with one large dispersing and one active pointed electrode?
 2. Bierman clamp?
 3. other modifications?

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In every instance one or both of these methods.

- (b) Electrodesiccation (monoterminal, Oudin type of current)? Occasionally.
 - (c) Fulguration (sparks? Not at all.
 - (d) Electric cutting current? Occasionally in conjunction with electrocoagulation.
 - (e) What is your opinion as to the relative place and merits of these high frequency methods as compared to each other? Coagulation preferred, particularly when applied with the Bierman clamp.
12. How does the use of the high frequency current methods compare with:
- (a) the clamp and cautery operation?
 - (b) the ligation and excision operation?
- In all but 1 instance, where the physician claims stenosis resulted from the use of coagulation, adding that this was due to faulty technique, etc., the use of the high frequency currents is considered distinctly superior to the clamp and cautery and ligation and excision methods.
13. Have you noted the effect of the use of the high frequency current on other rectal conditions found present along with the hemorrhoids, e.g. polypi, fissures and prolapse? Yes, in 12 instances, applied to polypi and fissures.

The essential facts to be noted in the questionnaire are as follows: That the group of doctors answering the questionnaire numbered 25; that they have been using the method during an interval of time covering six months to ten years, and that they have operated on a total number of 3284 patients.

The operation is usually performed in the office (23 out of 25). From this we may definitely conclude that the procedure is essentially an office one. The patient goes out of the office directly after the operation or may remain for a couple of hours. Patients operated on in the hospital remain there not at all or may stay for a period of a week. Patients are ordinarily advised to partake of a light diet before the operation and are told to have the lower bowel clean. To insure this latter condition they are advised to take an enema. Occasionally they are asked to

take a cathartic. After the operation the usual advice appears to be that they continue the light diet and that they take some mineral oil.

The operation is in nearly every instance performed under a local anesthesia. The anesthetic is injected into the base of the hemorrhoids, perianally and through the sacral route. The local anesthetics used are novocaine, procaine, butyn and quinine urea hydrochloride. In hospital cases use is made of gas oxygen and ether.

As to the types of hemorrhoids destroyed by this method, practically all types were mentioned, external, internal, complicated and uncomplicated. Some prefer to employ it in one type, others, in another type. Exception is taken to its use in very large gangrenous hemorrhoids. It is obvious that the technique may be modified depending upon the conditions found, e.g., in thrombosed hemorrhoids when it is possible to incise first, turn out the clot and then destroy the hemorrhoid bed. In small skin tabs preference may be given to the use of the dessicating current inasmuch as coagulation gives a greater amount of after pain when applied to the skin. The complete unanimity of opinion, that the end-results are good, is the interesting comment in the answers to this question. Exception is only made in the report of the first five cases performed by one man who felt that this difficulty was due to faulty technique. One other operator mentioned the possibility of stenosis. It is of course obvious that there is no automatic limit which can be placed upon the extent of the tissue which is destroyed. The safest of procedures can do damage when recklessly applied. The pertinent fact remains that stenosis does not usually occur because of the slight amount and the flexibility of the resulting scar tissue.

The consideration of the final end-result is the important one. It is the criterion by means of which the value of a procedure must be determined. As to immediate results, the important question of pain

after defecation elicited the answer that it was slight or moderate, as a rule. Occasionally there was none at all and

have been very moderate. In our own experience we have noted occasional bleeding after defecation with only 1 case of

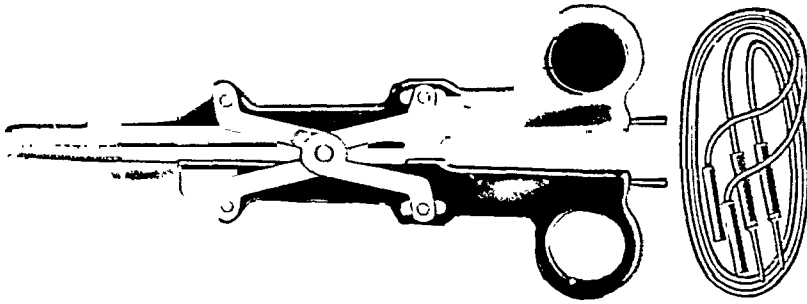


FIG. 1.

occasionally it was severe. When there is pain, it lasts from three to ten days, usually five. It is obvious that when tissue is removed or destroyed in this highly sensitive area, some pain should be expected. This can be greatly minimized at the time of operation if a few drops of 0.5 per cent quinine urea hydrochloride are injected into the tissues immediately adjacent to those destroyed. Radial incisions into the skin near the area of the destroyed hemorrhoid, made by means of a scalpel relieves the pressure of the subsequent edema, and thus prevents pain. The application of some ointment to the region helps to mechanically lubricate it; either simple vaseline or some preparation such as butesin picrate may be applied. To relieve the pain after defecation use may be made of a hot sitz bath or of hot, moist dressings kept warm by means of an electric heating pad pressed on top, the patient lying in bed, face down. Pain at times other than after defecation appears to be quite rare.

With reference to bleeding, the operative field is completely dry. Occasionally a few drops of blood are shed. The practically complete absence of bleeding appears quite dramatic to the surgeon, accustomed to seeing this as a bloody field. After the operation there is a serosanguineous discharge lasting several days. In the entire series, only 8 cases of secondary hemorrhage are reported and these appear to

real secondary hemorrhage. This occurred at the crucial period (ten days after the operation) when the coagulated area was separating from the healthy tissue in a severe diabetic who had twelve violent bowel movements at the time. To my knowledge, this is the only case that required packing. The patient may be incapacitated for a period varying from one to seven days. Occasionally the period of incapacitation is shorter and it may be longer than a week. Naturally the length of time during which an individual will stay away from his work depends on several different factors, such as the extent of the hemorrhoidal areas destroyed, the psychologic reaction of the patient (with the extreme variations in pain-standing ability), character of the work performed, etc.

Judging from the answers to the questionnaire, high and low voltage machines appeared to be used in about equal proportion. There does not appear to be any great difference in the action of these two types of machines. In our own experience the electrosurgical hemorrhoidal clamp appears to work better with the low voltage machines.

Four distinct variations of the application of the high frequency current are available in the destruction of hemorrhoids. As far as our methods are concerned, we allow the character of the redundant

tissue to determine which one or combination of these methods is to be used. If there be but a small varicose area, the

to be destroyed. The other technique is the use of a device consisting essentially of two active electrodes held in a clamp

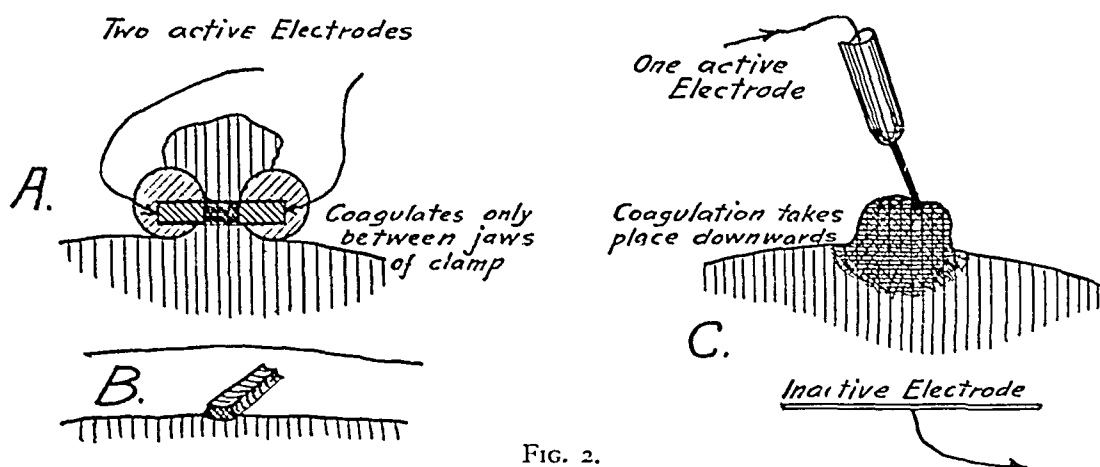


FIG. 2.

Oudin type of current is used, until a complete dehydration of the area occurs. We frequently intensify the action of this current by grounding. This is readily done by placing the patient upon a large metal electrode which is connected to a stem radiator or to a water pipe, etc. This method is called electrodesiccation. The destructive action of this current is not as intense as in electrocoagulation.

Fulguration consists in the showering of sparks from the tip of a pointed electrode held a short distance away from the tissue. The action of this procedure is a superficial carbonization. It is therefore but little employed.

The electric cutting current does not have sufficient coagulating power to seal the severed vein ends. It must therefore only be employed after the base of the hemorrhoid about to be removed, has been coagulated.

The procedure most generally employed is that of electrocoagulation. This current is a bi-terminal one with the same hook-up as that utilized in the usual medical diathermy, except that the current concentration is much greater so as to produce an actually destructive action. There are two methods of application: one is the use of a large dispersing electrode placed upon the skin in any part of the body, while the active pointed electrode rests on the area

so as to permit of their synchronous application on either side of the hemorrhoidal tissue. Histologic examination of tissue

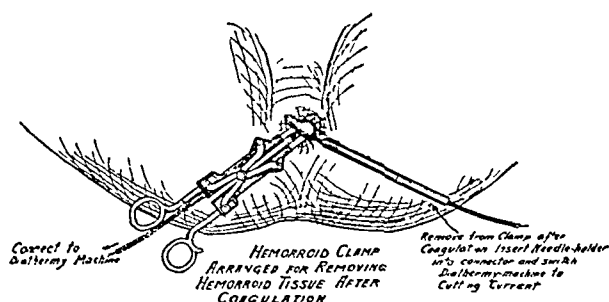


FIG. 3.

destroyed by means of electrocoagulation shows hyalinization with complete loss of cellular outline.

We employ the pointed active electrode where the tissues cannot be grasped by means of the electrosurgical clamp. When using the pointed electrode a diagram of the electro-motive lines of force would represent a cone with its apex corresponding to the pointed electrode and its base to the dispersing metal plate. The depth to which the tissue is destroyed is dependent upon several variable factors which cannot be accurately gauged. These factors include the amount of current used, the length of time during which it is permitted to act and the electrical resistance of the tissues. The electrosurgical clamp is the preferable one in every instance

where it is possible to apply it because the destroyed area is more definitely delimited. The coagulation occurs only in the area lying between the jaws of the clamp. This obviates the danger of destroying too much or too little tissue. The uncertainty as to the depth of the destructive effect of the current is removed. The area is destroyed exactly as desired, permitting the immediate removal of the hemorrhoid.

The action of the electrosurgical hemorrhoid clamp is in no way comparable to that of the ordinary surgical clamp used in the clamp and cautery method. The ordinary surgical clamp compresses the tissue at the base of the hemorrhoid, insuring hemostasis when the tissue beyond it is removed. The electric clamp has only very slight compressing action, being so constructed that its jaws are separated where they are applied against the hemorrhoid. The very purpose of this separation is to prevent compression of the hemorrhoidal tissues, thus insuring a broad base which can be coagulated by the action of the electrical current. In the usual clamp and cautery operation, an artificial tuck of skin, of mucous membrane, or of both, is made and the tissue removed along a very thin linear area. This area is then seared over with actual cautery. What happens, therefore, is a superficial carbonization of tissues over a thin line. With this technique, the occurrence of secondary hemorrhage may be explained by the tendency of the adjacent remaining tissue, which has thus been artificially tucked, to pull apart, the gluing action of the thin and superficial carbonized area being insufficient to hold it together.

Using the electrosurgical hemorrhoid clamp, the destructive action actually occurs within the tissues embraced by the clamp. The resistance of the tissue to the passage of the electric current of high frequency, which is traversing it between the two active electrodes on either side, causes the development of heat sufficient to coagulate it. The destroyed area thus has sufficient width and depth to hold the healthy ends of tissue firmly together and to thoroughly cover the healthy tissue underneath.

After the base of the hemorrhoid has been coagulated, the area above it may be removed by means of scissors, scalpel, or the electric cutting current. This is better than permitting the tissue to remain in situ until it sloughs off ten days to two weeks afterwards, the dead mass acting like a foreign body, causing mechanical irritation and producing an offensive odor as it decays.

The action of the diathermy current differs markedly from that of the actual cautery in that the heat is produced within the tissues, due to the resistance which they offer to the passage of the electric current, while with the cautery, the heat is applied from an external source. In diathermy the electrodes do not become hot. With the cautery the applicator is red hot. This difference is a fundamental one, and accounts for the greater effectiveness of diathermy, and the particular value of its use in hemorrhoidectomy.

From these observations it is reasonable to conclude that the high frequency current is well adapted for the treatment of hemorrhoids.



A CASE OF UTERINE FIBROID SEPARATED FROM ITS PEDICLE*

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FROM the small number of reported cases of uterine fibroids separated from their pedicles, this would seem to be a rare condition. I have been unable to find the report of a case found to have an acute separation.

Internal hemorrhage from pedunculated fibroids has been reported. Rokitansky¹ and Perrier² each reported a case in which there was a severe hemorrhage from a ruptured vein on the surface of a fibroid. Bruce Clarke³ reported a similar case. Paul Zweifel⁴ mentioned a case in which four days after a four months' miscarriage, a patient had a sudden and rather severe internal hemorrhage found to be due to a ruptured vein and artery on a fibroid. Lockyer⁵ reported a case of hemorrhage from distended veins in torsion of the pedicle of a fibroid.

Cases have been reported in which there is complete separation of the fibroid from the uterus with the development of a new blood supply. Two such cases were mentioned by Lockyer,⁶ and two by Cullen.⁷ In these cases the new blood supply was from vessels in the omentum where it had become adherent to the tumors.

Wylie⁸ reported a case of calcareous fibroma, detached from the uterus and rolled up in the omentum. It had no blood vessels entering it and the body tissues had treated it as a foreign body. A severe melancholia of previously undetermined origin was cured by the removal of this tumor.

A number of other cases of so-called "migrating fibroids" have been reported. They obtain their blood supply from the vessels of various abdominal structures and are entirely separate from the uterus. Examples of these are given in references twelve to eighteen.

Cullen⁹ mentioned a case, reported to him by Dr. Bastenelli of Rome in a personal communication, in which the body of the uterus had spontaneously separated from the cervix. The woman had had several attacks of peritonitis. At operation the body of the uterus was found adherent to the anterior abdominal wall and entirely separated from the cervix. This had apparently been caused by a gradual torsion of the uterus by fibroids.

In all of these cases if the separation was acute it had occurred a considerable time before the operation. The more probable explanation is that the separation by torsion and development of the new blood supply was a very gradual process.

Cullen¹⁰ wrote of a case of pedunculated fibroid which was shown to his students and examined by them immediately before operation. Upon opening the abdomen several hundred cubic centimeters of fresh blood were found in the pelvis and brisk bleeding was located as coming from a tear in the pedicle of the fibroid. He attributed this to the manipulations of the tumor during the examinations.

Maugeri¹¹ reported a case in which three very large fibroids were expelled from the uterus into the vagina, however without complete spontaneous separation from the uterus.

CASE REPORT

Mrs. M. K., a housewife, aged forty-two, entered Knickerbocker Hospital, Jan. 12, 1930, complaining of pain in the lower abdomen. While sitting in a theater the night before admission, she felt a sudden sharp pain in the lower abdomen. She then became quite faint. The pain continued after she reached home and had gone to bed. She was nauseated but

* From the Surgical Service of Knickerbocker Hospital, New York. Submitted for publication April 9, 1931.

did not vomit. By 5 A.M. the pain had become so severe that she called an ambulance.

Her entire past history was negative. Menstruation was always regular; the last period ten days before admission. She had two children, the youngest twelve years of age.

Physical examination was that of a well nourished and developed white woman about forty years of age who appeared acutely ill. The abdomen was symmetrical and slightly distended. There was no dullness in either flank. The entire abdomen was tender but this was most marked just above the pubis. Pelvic examination showed no discharge or bleeding. The body of the uterus could not be outlined. A large tender mass filled the pelvis. In the right fornix and posterior cul-de-sac was a distinct bulging which felt boggy. The bladder was distended but after catheterization the pelvic findings were unchanged. Also an area of dullness remained which extended about 3 in. above the symphysis pubis.

At the time of admission, patient's pulse was 80, temperature 97°F. and respirations 20. Blood count was red blood cells 4,000,000, hemoglobin 75, leucocytes 19,300, polymorphonuclear leucocytes 85 and lymphocytes 15. Urine was normal but for a trace of albumin.

Jan. 13, 1930. Pelvic findings were unchanged. Temperature ranged between 98 and 100°F. Pulse had increased to 112.

Jan. 15, 1930. The pain became much more severe, but her temperature remained between 99 and 100°F. The pulse had increased, now ranging between 110 and 128. The tenderness and rigidity had also increased. The dullness above the pubis remained unchanged. The blood count was: Red blood cells 3,500,000, hemoglobin 67, white blood cells 24,200, polymorphonuclear leucocytes 92 and lymphocytes 8.

Because of the decrease in the red count and hemoglobin, the increase in the leucocyte count and pain, immediate operation was decided upon. A diagnosis of pelvic abscess or ruptured ectopic pregnancy was made.

Pathological Findings: An exploratory needle introduced into the bulging posterior cul-de-sac produced fresh blood. Upon opening the abdomen a large amount of bloody fluid was found. The pelvis contained fresh bright red blood and many clots. A large necrotic fibroid lay in the lower abdomen, resting on the brim of the pelvis. It measured 8 by 8 by 6 in. and

was completely wrapped in omentum and loops of intestine excepting for a small area anteriorly, which was adherent to the anterior abdominal wall and bladder. The majority of the adhesions were fibrinous and separated readily. There were fibrous adhesions to a part of the omentum, one loop of ileum, and one small place on the sigmoid colon. These areas had the appearance of sarcomatous infiltration.

The tumor was found to be resting against, but not attached to its pedicle from which there was free bleeding. This pedicle was a flattened inverted cone measuring 2 in. across the raw surface. The apex was well down in the body of the uterus.

A hysterectomy was decided upon because of the possibility of malignancy.

Operative Procedure: With patient in lithotomy position the posterior cul-de-sac was explored with a needle. A lower midline incision was then made. This was later extended 1½ in. above and to the right of the umbilicus to permit delivery of the tumor. All of the adhesions to the tumor were freed and the resulting raw surfaces peritonized. A supravaginal hysterectomy was then done, the tubes and ovaries were left in. The raw surfaces in the pelvis were peritonized and the abdomen closed by layers without drainage.

PATHOLOGICAL REPORT

Macroscopic Examination: Specimen consists of a uterus without adnexa. It measures 7 by 4 by 4 cm. On section the uterine wall is found to be grayish in appearance, soft in consistency and irregular in thickness, varying from 2 to 4 cm. The uterus is ovoid in shape. On the fundus is an everted mass from the center of which protrudes a polyp 2 cm. in diameter. There is also a flat ovoid mass measuring 14 by 13 by 5.5 cm., soft in consistency, variegated in color, dark brown areas intermingling with grayish white areas. On section it presents some resistancy, hemorrhagic areas, and some that are yellow and brown.

Microscopic Examination: The uterus shows an increased number of muscle fibers and dilated blood vessels. The mass is a fibroid containing many necrotic and degenerating areas. The polyp is a polypoid adenoma of the uterus of endometrial origin.

Convalescence was uneventful. The wound healed by primary intention. The patient was discharged as cured on Feb. 3, 1930. The scar

was firm and pelvic examination negative. Examinations at intervals of three months since have shown her to be normal in all respects.

SUMMARY

A case of uterine fibroid is reported which at operation was found to be separated from its pedicle. This may or may not have been complete. It is readily possible that a remaining connection could have been

separated while the fibrinous adhesions were being freed between the tumor and the surrounding structures.

The condition of the fibroid and the hemorrhage into the pelvis would indicate an acute severance of the pedicle of the tumor, at least so nearly complete that the blood supply was cut off. A peculiar condition was found in that the center of the pedicle was made up of a polypoid adenoma arising from the endometrium.

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HYSTEROSALPINGOGRAPHY

BY MEANS OF IODIZED RAPESEED OIL*

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ALTHOUGH the use of iodized rapeseed oil (campiodol) for roentgenographic exploration has been re-

campiodol⁴ in upwards of 30 hysterosalpingographies. I have made a special effort to observe these patients following the

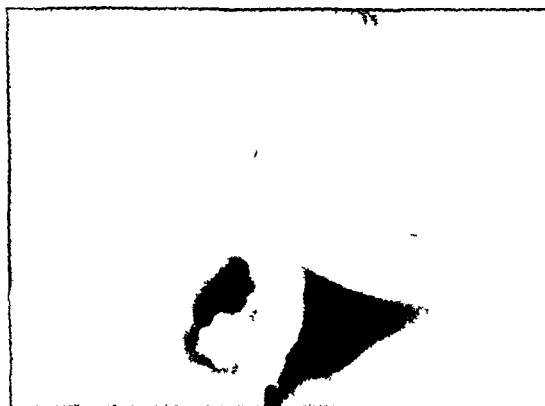


FIG. 1A. Uterus and tubes injected with campiodol. Left tube is closed at cornual end. Right tube is filled to its distal end and is closed at this end, there being a mild degree of hydrosalpinx.



FIG. 1B. Film taken twenty-four hours after injection of uterus and tubes with campiodol. Note shadow of campiodol retained in hydrosalpinx. Same case as Fig. 1A.

ported by Frazier¹ and by Glaser, Futch and Snure;² and emulsified campiodol has been used by Kutzman³ as a pyelographic medium, no one as yet according to Witer, et al.,⁴ has reported on the use of this oil in visualizing the uterine and tubal cavities.

Campiodol, as described by Frazier¹ has an iodine content of from 43 to 45 per cent, a specific gravity of 1.289 and relatively a low viscosity of 250 to 100° F. It deteriorates very slowly when exposed to light or heat. This iodized oil shows no toxic effects upon intravenous or subarachnoid injections. Frazier thinks that iodized rapeseed oil is as inert a material as can be obtained for this purpose and that it is non-irritating to the body tissues.

At the suggestion of Dr. Raiziss, who collaborated with Frazier and Glaser in the elaboration of campiodol,⁵ I have used

injection and I have found no ill effects whatsoever from its use. Moreover I find no disadvantages in the use of this oil and it has one strong advantage over other oils,^{5,6} that I have used, namely, its low viscosity. Less pressure is needed for the injections, hence there is less time used per injection and less pain to the patient.

The shadow-casting property of campiodol, when injected into the uterus and tubes is highly satisfactory (Figs. 1 to 6).

TECHNIQUE OF INJECTION

Needless to say, in the injection of iodized oil into the uterus and tubes, one should exercise the principles of strict asepsis. The patient should receive an enema and empty the bladder prior to the

* This product consists of four parts campiodol and one part ethyl olive oil.

* Submitted for publication March 2, 1931.

injection, although failure to do this does not preclude good results. The patient is placed in the lithotomy position over a

rubber tip actually plugs the external os and acts as a cork. If the oil should be too viscous, warming will make it flow

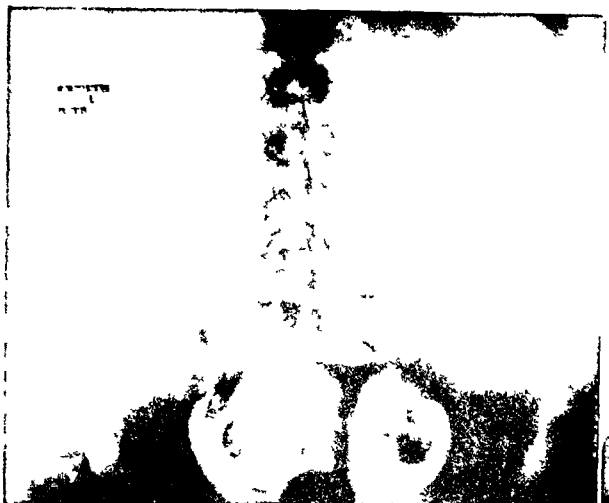


FIG. 2. Uterus and tubes injected with capiodol. There is marked spilling through distal end of each tube.



FIG. 3. Uterus and tubes injected with capiodol. Note elongation of uterus; stricture at internal os; marked deviation of fundus to one side; well-filled tubes with spilling at both distal ends.

Bucky diaphragm with the film in place. A bivalve speculum is then inserted into the vagina and the cervix is exposed. The vagina and cervix are carefully wiped free of mucus, and the cervix and the external os are painted with tincture of iodine. The anterior lip of the cervix is then grasped with a volsellum and a sound is introduced into the uterus to determine the direction of the uterine cavity and its depth. (The larger the uterine cavity, the more oil is required.)

For injecting the oil, I use a modified Keyes-Ultzman urethral cannula with a rubber tip attached. The cannula has a soft pliable rubber acorn attached about 4 cm. from its end. When the cannula is inserted into the uterine cavity slight pressure on it causes the small end of the rubber acorn to fit snugly into the external os of the uterus and thereby stops leakage of the iodized oil from the uterus during the taking of the roentgenogram.

A syringe containing approximately 20 c.c. of oil is fitted into the cannula by means of a bayonet attachment. The cannula is then inserted into the uterine cavity in the direction made by the sound, so that the

more easily. Capiodol flows freely without being warmed. The oil is then injected slowly and carefully until approximately 3 c.c. have been injected. At this point the patient experiences slight uterine contrac-



FIG. 4. Uterus and tubes injected with capiodol. So-called sphincter of Kennedy is clearly visible at cornual end of tube.

tions and after a pause of a few seconds more oil is injected. The amount of oil injected is variable, depending, first, on the size of the uterine cavity, and second, on the amount of resistance felt. (A large or deep uterine cavity will hold more than 10

c.c. of the oil and a small uterine cavity, with the cornual ends of the tubes obstructed, will offer marked resistance to

the oil have been injected it is well to ask concerning the uterine cramps and to give assurance that they will soon pass off. In



FIG. 5. Bicornuate uterus injected with campidol. This roentgenogram was taken through an enormous ovarian cyst.

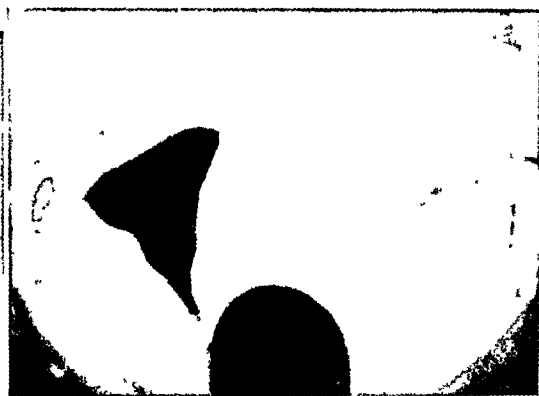


FIG. 6. Uterus and tubes injected with campidol. Note stricture at internal os. Note conformation of tubes indicating former tubal infection.

over 5 c.c.) From 5 to 8 c.c. of the oil will fill the average uterus and tubes. When one estimates that the uterus and tubes are filled the injection is stopped, the cannula is held in position, the signal is given, and with the instruments in position, the flash is made.

There is no doubt that the use of the manometer is a refinement in the technique. Jarcho⁷ has devised an instrument which is an excellent piece of apparatus and is extremely practical. I am absolutely convinced that a manometer of some type should be used to avoid the possibility of excessive pressure. The upper limit of pressure should be 200 mm. of mercury.

During preparation for the injection of the campidol the patient is apt to become apprehensive. For this reason it is wise to explain in detail just what is to be done and in what manner the picture is to be taken. Warning should be given that slight uterine cramps will be felt and that any movement on her part after the procedure has started will necessitate an additional injection. Gentle admonition is wise before grasping the cervix with the tenaculum and again when the uterine sound is passed and the cannula is inserted. After 3 c.c. of

my experience it has been only the neurotic patients who have suffered any inconvenience during or following the use of this diagnostic maneuver (in no patient have I been unable to complete the procedure). With the aid of a good light and accessible instruments the entire injection can be made, together with the taking of the skiagram, in less than two minutes from the introduction to the removal of the speculum. The patient is then turned on her side and a lateral view taken. This makes for additional precision. A part of my routine consists in the taking of twenty-four-hour plates to determine the possible presence of leakage into the peritoneal cavity where the tubes have been thought to be closed at the first examination. This procedure may be of further value in demonstrating the retention of the opaque substance in an hydrosalpinx which is permeable at the cornual end. I have operated on many of these patients following the injection of campidol. I have found no evidence whatsoever of peritoneal irritation following the injections, and no signs that the campidol was at all toxic to the peritoneum.

[For References see p. 642.]

STAPHYLOCOCCEMIA FOLLOWING CESARIAN SECTION: RECOVERY

REPORT OF A CASE WITH A RARE ANATOMICAL ANOMALY*

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THIS case is being reported on account of its many unusual features, the most outstanding of which are:

1. A rare congenital anatomical anomaly, necessitating a cesarian section.
2. An unusual type of infection entering the blood stream, with positive cultures recovered from the blood and other body fluids.
3. The extreme hyperpyrexia and complications.
4. The treatment and recovery.

Mrs. F. H., twenty-two years old, married six months, gravida zero, consulted me on November 28, 1927, on account of not having menstruated during that month. She gave her menstrual history as having commenced to menstruate at the age of sixteen, of the thirty-day type, and four to five days' duration. She was always regular, and the periods were never accompanied by premenstrual comenstrual, or postmenstrual pain. Her last menstrual period occurred on October 1, 1927. She was, therefore, four weeks past her expected period.

She had employed contraceptives for the first few months of her married life, but discontinued them two months prior to the consultation.

Examination: Weight, 131 lb.; height, 4 ft., 11½ in.; chest and abdomen, negative and urine, normal. The external pelvic examination revealed a normal bony contour, with normal pelvic measurements.

The vulva presented a normal appearance, although the introitus was unusually relaxed and large, for a nullipara.

Introduction of two fingers into the vagina revealed some unusual and interesting findings. The vagina was unusually short, shallow and wide, its length from vault to introitus being about 1½ in.

There was complete absence of a cervix; nor could the examining finger locate an opening or depression where, normally, a cervix or

entrance into the uterus should be. The impression conveyed, was, that the finger was in a shallow, cup-shaped, smoothly-lined cavity.

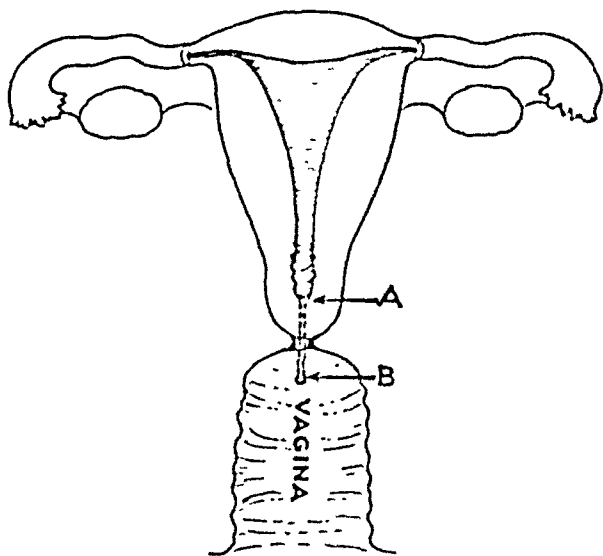


FIG. 1. Cervical anomaly as it appeared to examining finger. A. Lower uterine segment with very narrow canal into uterus. B. Pinpoint opening of canal into vaginal vault.

Bimanually, a uterus could be palpated, which was of normal size, easily movable, in good position, and apparently attached by its cervical portion to the vault of the vagina, intrapelvically. Adnexa could not be palpated. Rectal examination did not elicit any further information.

A speculum examination revealed the short, shallow cup-shaped vagina, with total absence of a cervix. A thorough search of every part of the vagina with a fine probe failed to reveal any opening into the uterus, or into any other adjacent structures. The patient returned two days later for further examination. The vagina was cleansed and dried, and under special illumination every part again examined with sound and probe. Again, no opening or depression could be located.

Owing to my skeptical attitude as to her menstrual cycle, the patient refused further

* Read before the Brooklyn Gynecological Society. Submitted for publication March 12, 1931.

examination. Exactly three months later she appeared again at the office, and to my surprise I found the fundus of the uterus one finger's

Hospital. Examination showed a head presenting, not engaged, dorsum to the right, fetal heart in the right lower quadrant, of good rate

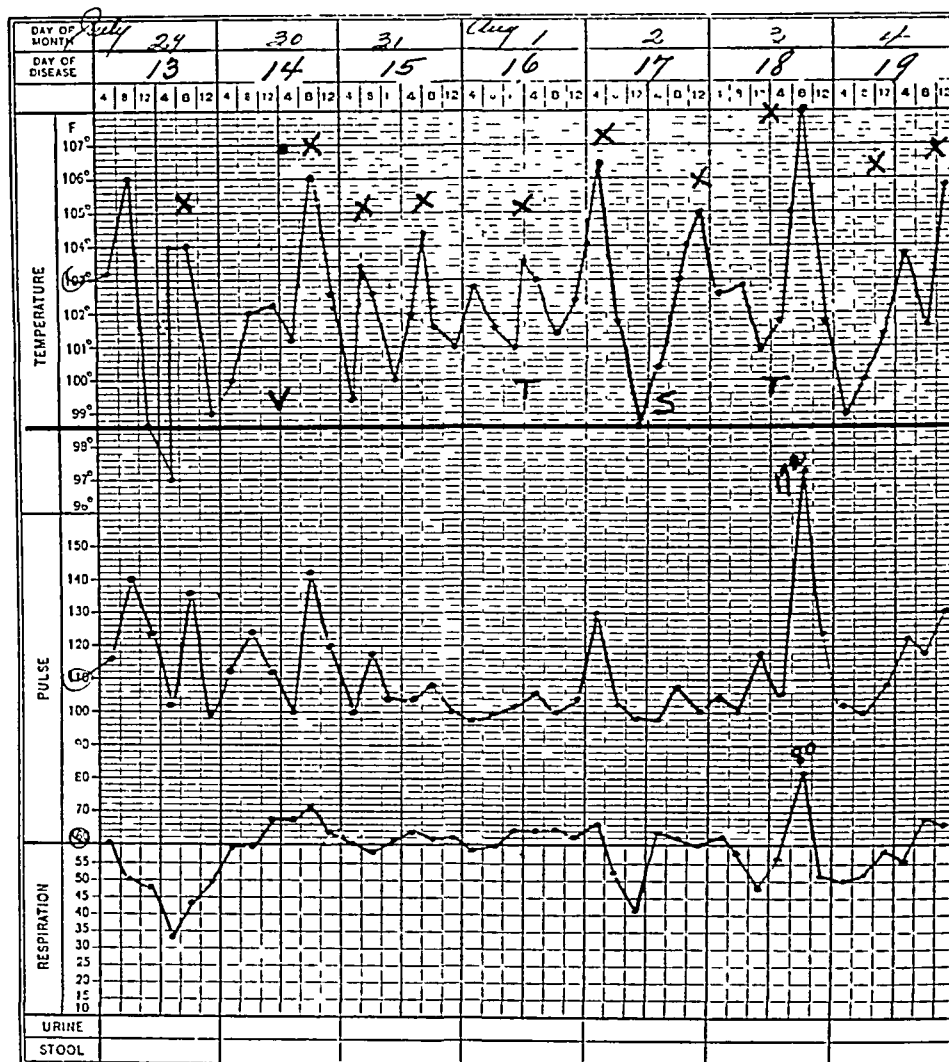


FIG. 2. Extreme excursions of temperature, high pulse and respirations, and frequency of chills. x. marks daily chills. v. Cultures taken at this time showed only 5 colonies after seventy-two hours. s. Cultures taken at this time were sterile after seventy-two hours. t. Transfusions.

breadth below the umbilicus. One month later, a fetal heart could be located.

Though I was now certain that the patient was pregnant, the puzzle was, nevertheless, not yet solved as to the opening into the uterus, as similar searches and probing were carried on at almost each visit to the office.

The patient's last menstruation was October 1, 1927; the estimated date of delivery was, therefore, July 8, 1928.

On July 15, at three P.M., the patient was admitted to the Brooklyn Hebrew Maternity

and quality. The patient complained of weak, irregular pains. Five hours later the pains were every five minutes and much stronger. Three hours later a vaginal examination was done. No opening of any kind could be located; but through the thickness of the vaginal vault a one-finger opening into the uterus could be made out through the intrapelvic portion of the cervix (if indeed, a cervix it was).

A cesarian section was immediately performed, and a living, normal male infant weighing 7 lb., 2 oz., was delivered.

The incision was made into the midline and lower half of the uterus, the incision encountering the placental site. Closure was effected with

continued throughout the febrile course, ranging anywhere from 36 to 84 per minute. The usual postoperative temperature set in,

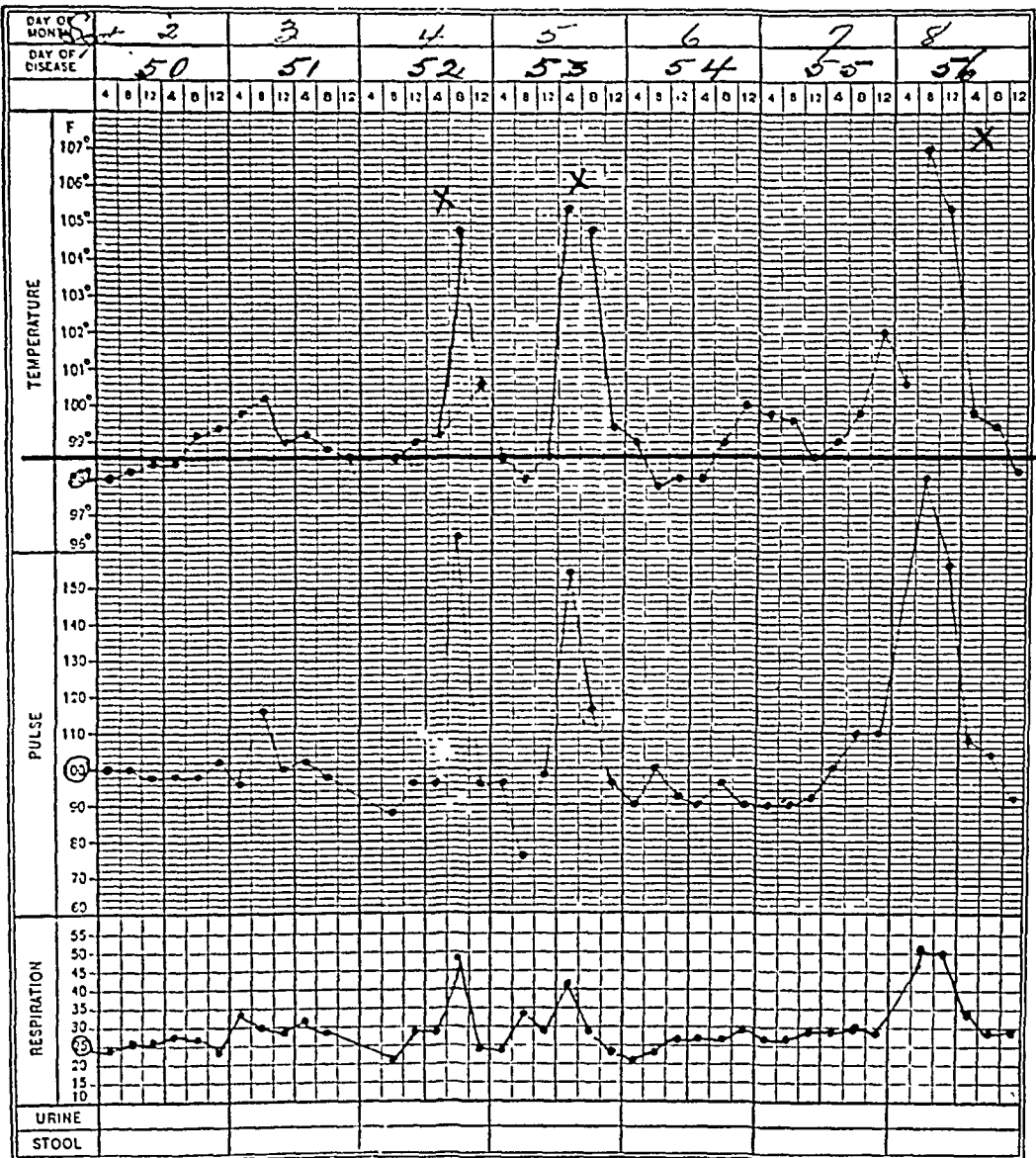


FIG. 3. Reappearance of chills, as marked by x, after transfusions had been discontinued for a week; also the rising again of the temperature, pulse and respirations.

two layers of interrupted chromic catgut No. 2, and peritonealized with a continuous suture.

Examination of the uterus and appendages at the time revealed normal tubes and ovaries. It was not deemed advisable at the time to explore the pelvis for anatomical curiosities.

The patient was put to bed in apparently good condition, and a Harris drip instituted. Four hours later the pulse was 90, blood pressure 120/74 and respiration 40. The rapid respirations commenced at the outset and

which gradually came down to normal by the fourth day. The lochia was sanguineous, rather scant, and rapidly changed to a grayish color by the fourth day, and became foul-smelling within another day. Concomitantly with this, the temperature commenced to rise again, reaching 103°F. on the fifth, and 105.2°F. on the sixth day. The respirations ranged between 40 to 50 per minute, and the patient became prostrated. Chilly sensations accompanied the rise in temperature, but they were of brief

Pus drained through the tube very well; but within forty-eight hours the tube was expelled.

On the eighth day the patient suffered a severe chill lasting thirty-five minutes, the temperature rose to 106°F., and she appeared extremely toxic.

Dr. John O. Polak who examined the patient at this time, thought that she was suffering from a lochiametra with absorption, and the possibility of a pulmonary embolus that had occurred immediately after the operation.

Within thirty-six hours after the blood was cultured, the laboratory reported the presence of innumerable colonies of *Staphylococcus aureus* of the hemolytic type.

A transfusion of 150 c.c. of blood from a typed donor was given, with hopes of repeating it every other day. The patient's condition, however, grew worse the next day, and Dr. Polak was asked to see the patient again. An abstract of his opinion is as follows:

"Patient's circulation is failing, and her condition is desperate. Would *not* do any transfusions, but would inject intravenously, either rivanol or mercurochrome. Would also use the puerperal anti-streptococcus serum of Dr. Falls—Lilly."

This was done. The patient received 40 c.c. of the serum intramuscularly every day, for five days; and 2 intravenous injections of rivanol. The blood count remained the same; but a blood culture taken again on the thirteenth day postoperatively, after the patient had already received 4 doses of the puerperal serum, and 2 doses of rivanol, showed only 5 colonies of the *Staphylococcus aureus* after seventy-two hours.

Another culture taken four days later was sterile after seventy-two hours.

Despite this improvement in the blood stream infection, the chills continued unabated, the temperature ranged from 96 to 108°F., and the patient was in extremis almost daily.

The abdominal wound which had healed firmly by primary union, commenced to slough; marked edema of the vulva developed, as well as passive congestion with profuse râles, in the right lung. Within two more days this right side of the chest became flat to percussion, and breath sounds disappeared. A portable x-ray plate revealed the presence of a right-sided effusion probably encapsulated. Small areas of consolidation were also scattered in the left lung. Respirations were extremely

embarrassed and ranged anywhere between 50 and 80 per minute.

A needle was inserted into the encapsulated area and 25 c.c. of turbid, yellowish fluid were aspirated. Three days later a similar amount was withdrawn. This fluid showed a pure culture of the *Staphylococcus aureus*.

The serum not being obtainable anymore,* we resorted to blood transfusions from donors that were immunized to the *Staphylococcus aureus*. The quantity ranged from 150 c.c. to 250 c.c., and was given every other day until the chills abated, then every third day. In all, the patient received one transfusion in the beginning, and then 12 transfusions from immunized donors, until all the chills disappeared, and until the temperature was below 102°F.

During this time the patient developed multiple abscesses over the abdomen, chest, thighs, etc., 14 in all. Two large Bartholin abscesses appeared at about the same time. All the abscesses were incised and drained. Cultures obtained from the abscesses contained the same strain of *Staphylococcus aureus* hemolyticus.

The lungs gradually cleared up, the abscesses healed, and the patient made a slow and tedious recovery. She was in the hospital three months.

Examination of the patient three months later showed the uterus to be of normal size, in second degree retroversion, and the adnexa negative.

The opening in the vault of the vagina was barely visible, and just admitted a uterine sound.

As to the Anomaly: A search of the current textbooks in obstetrics and gynecology, both in English and in German, fails to shed much light on this anomaly, except that it is mentioned as a rare malformation of the uterus.

Albutt, Playfair and Eden¹ refer to it as "uterus acolis," the total absence of the cervix, or "uterus parvicolis," a uterus with a rudimentary cervix. Penrose,² quoted

* This puerperal anti-streptococcal serum was prepared under the formula and direction of Dr. Falls of the University of Illinois. The serum was not on the market, but a limited supply was obtained by Dr. Polak who was kind enough to give us all he could spare.

by these authors, cites such a case. Bland³ in the first volume of his "Gynecology" says: "sometimes the cervix is rudimentary or entirely absent." Schauta⁴ says that the absence of the cervix is extremely rare; and Kermauner⁵ in his exhaustive monograph on uterine malformations gives it but brief mention. Menge⁶ simply mentions the possible absence of the cervix and places it in the proper order of the uterine malformations.

As to the Infection: It is common knowledge that staphylococcemia is not the usual type of infection following cesarian sections; yet such infections are by no means rare. This case, however, was particularly marked by its enormous severity, the

extreme excursions of the temperature, the rapidity of the respirations, the frequency and durations of the chills, and the numerous complications.

As to the Treatment: There is no way of determining whether in this case it was the puerperal serum, the rivanol, or any other factor that caused the blood cultures to become sterile so early in the disease, though the chills still continued on; but I am confident that the blood transfusions of the immunized donors were a decided factor in the alteration of the blood stream infection, as shown by the disappearance, reappearance, and the final disappearance again, of the chills, when blood transfusions were again instituted.

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*Continued from p. 636.

FOCAL INFECTION*

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EVANSTON, ILL.

IN private practice prenatal care constitutes one of the best contributions to preventive medicine that the medical profession has developed. A great deal has been written lately about the need for teaching preventive medicine in our medical schools and various men have made the statement that even though our present-day physicians would attempt to practice preventive medicine privately, they would not have adequate training to make it a success. It is up to the coming generation, therefore, to develop and to establish preventive medicine in private work.

Obstetrics, not only in prenatal care but in all of its phases, is essentially preventive. It is not surprising, therefore, that we find preventive measures develop in obstetrics that are not seen in other branches of medicine. The average obstetric patient makes about twelve to fifteen visits to the doctor's office prior to delivery. During that time she is watched most carefully for the development of toxemia, anemia, obesity, miscarriage, thyroid toxemia, etc. At the same time she is given the benefit of various examinations. The care which has been developed so far, however, constitutes only a small part of what is possible to accomplish and among those things which we have somewhat neglected in the past, I feel sure that focal infection should be included. There have been no routine measures adopted by the average obstetrician to detect or clear up various foci of infection although a number of men have written very good papers stressing their importance.

Focal infection has been definitely proved to be an etiological factor in miscarriage, pyelitis, mastitis, phlebitis, anemia and toxemias of pregnancy.

Curtis,¹ in 1916, reported 2 cases where a mother's urine, placenta and fetal heart blood in still-birth yielded large numbers of streptococci which, when injected intravenously in pregnant guinea pigs produced abortion in every case and streptococci in pure culture were recovered from the uterus.

Nickel and Mussey² of Mayo's in 1927 summed up their experimental work on focal infection as a cause of abortion as follows:

Abortion in guinea pigs has been produced experimentally by the intravenous injection of strains of green producing streptococci isolated from foci of infection in patients who aborted. The premature emptying of the uterus in animals seemed to be due to the elective localization and growth of the streptococci in the placental site and death of the fetus due to invasion of its blood stream by this streptococcus. These streptococci lost their specificity on artificial mediums. Control strains from foci of infection in patients never having aborted injected in like manner and in equivalent doses did not produce experimental abortion.

Talbot³ in 1922 wrote two very good articles on chronic infection in pregnancy and tried to demonstrate that these foci of infection cause infarcts in the placenta which he, in turn, thought was a factor in producing pregnancy toxemia. Montgomery,⁴ however, has recently proved that these infarcts are due to a physiological phenomenon and are found to some degree in every placenta. Talbot cites cases, however, where focal infection was the cause of mastitis and pyelitis and also miscarriage. He even goes so far as to say that probably certain fetal deformities and hemorrhagic disease of the newborn are due to chronic infection in the mother.

* Read before the Evanston Branch of the Chicago Medical Society April 2, 1931.

Johnson, Johnston, and Nicholas⁵ of Houston, Texas, make the statement that bacillus coli infection is present in practically every case of toxemia of pregnancy. They think that focal infection lowers the resistance and the bacillus coli have a better chance to invade the organism. They think, too, that focal infection is a factor in the toxemia of pregnancy because bacteria and their enzymes acting on certain amino-acids in the blood stream form poisonous amines. There is no large quantity of amino-acids in the blood stream as a rule but they think that certain things such as renal disease or the ingestion of large amounts of meat might increase them thus causing toxemia.

Doctors W. C. Danforth and B. C. Corbus⁶ in a paper on pyelitis in 1927 state that "as pyelitis is secondary in a large group of cases to foci of infection in the teeth, tonsils and sinuses, these regions must be cleared of infection as the first step in its management." Rose and Rollins⁷ of St. Louis in a recent article on pyelitis of pregnancy advocate removing all foci of infection as a preventive measure. Focal infection has also been found to be a contributory factor in secondary anemias and I have been able to demonstrate an increase in hemoglobin and red cells following the removal of certain foci of infection even in pregnancy and a few cases of anemia that have persisted long after delivery have been benefited by the removal of certain chronic infections.

The cervix is not thought of as a common source of infection but it has been definitely proved to be in a small number of cases and although conception is not apt to take place if the cervix is badly infected, nevertheless now and then it does occur. Mayo,⁸ Langstroth, Sturmdorf, Rosenow and Dickinson have all cited cases where the cervix proved to be a focus of infection capable of causing systemic symptoms. If the patient should present herself prior to conception for a check-up, as she many times does, the cervix should be treated and

put into the very best condition possible because after pregnancy begins the secretions coming from the cervix may furnish a great deal of discomfort and may in some cases, I think, even lead to miscarriage.

These focal infections are found most commonly in teeth, tonsils, sinuses and the kidney. Of course, the most common location is the teeth or tonsils and especially the teeth for an area of infection at the base of a tooth can drain only into the circulation. It may produce no symptoms whatever but it is constantly exposed to pressure by mastication. That the kidney is a focus of infection is probably not entirely correct but we do see a number of cases that have a chronic infection in one or the other kidney that will respond to proper drainage or treatment and these chronically infected kidneys should be treated prior to conception or at least in the early months of pregnancy.

In November, 1929, I decided to take a full mouth x-ray on all patients coming for the care of pregnancy. Since that time 242 pregnant women have come for care. The x-rays of their teeth have all been taken by Dr. Melvin A. Root, Jr. The patient is given a slip to Dr. Root who in turn sends me a written report on the condition of her teeth. The x-ray is then mailed to her dentist within a few days. If Dr. Root's report shows the presence of infection, I communicate with her dentist and in some cases examine the film also. If the three of us agree that an apical abscess exists, she is advised to have the tooth removed. Out of these 242 women, 57 reported at the time of their first visit that they had had a recent full mouth x-ray, that is, within a few months. This, I believe, goes to show that they are a class of women accustomed to very good dental care. One hundred and eighty-one full mouth x-rays were taken and 4 women have not yet submitted to the examination. Of these 242 patients, 36 had apical abscesses which represents 15 per cent. In other words, from routine examination of the teeth of patients in this com-

munity coming for the care of pregnancy, we are able to demonstrate that 15 per cent are harboring chronic infection. Besides these infections we would naturally expect to find other sources of infection that the x-ray is unable to show, such as tonsils, and such is the case for in 1929 I had 9 cases tonsillectomized and last year, 3 cases. Out of the 36 cases of apical infection discovered during this period of seventeen months, 25 patients had extractions performed, 1 had a tooth drained, 4 refused and 6 are yet to have it done. These six women have signified a willingness to do so, however, at their earliest convenience.

Some writers state that they do not think dental extractions and other dental work should be done because of the possibility of dissemination of infection causing miscarriage, etc.; but I feel sure that the patient runs a greater risk by harboring the infection than she does by having it removed. None of the 25 patients having extractions miscarried and none of the patients that I have had tonsillectomized have miscarried.

It is very hard to demonstrate any benefit from a preventive procedure such as the removal of various foci of infection but since adopting the measure as a routine, I have had fewer cases of pyelitis, mastitis and toxemia.

SUMMARY

In summarizing the preceding I wish to state the following:

1. It is probable that about 15 per cent of all women presenting themselves for the care of pregnancy in this community are harboring focal infection at the apices of their teeth.

2. Since focal infection has been very clearly demonstrated to be a source of danger to the average pregnant woman, I think that in the routine care of pregnancy we should include a full mouth x-ray of the patient's teeth as a part of the first examination.

3. Since harboring a chronic focus of infection is probably a greater risk than its removal, I think all foci of infection should be removed early in pregnancy.

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DIAGNOSTIC PNEUMOTHORAX

A GUIDE IN THE LOCALIZATION, TREATMENT, AND PROGNOSIS OF PULMONARY ABSCESES*

WILLIAM B. FAULKNER, JR., M.D.

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THERE are certain underlying mechanical differences caused by pleural adhesions even in those patients with pulmonary abscesses who present strikingly similar histories, physical findings, and roentgen-ray shadows. These adhesions can be visualized and their extent, localization, and influence can be measured if air is introduced into the pleural cavity. Diagnostic pneumothorax aids not only in selecting the proper type of treatment and in guiding the prognosis but also in presenting the problems to be met at operation so that one may be prepared for them. Pneumothorax is easy to perform and does not aggravate the patient's condition.

METHOD

The air is introduced under local anesthesia by a method similar to that used for the induction of a therapeutic pneumothorax in pulmonary tuberculosis. The patient is placed in a horizontal position with the side uppermost into which the air is to be introduced. This is a precautionary measure against the possibility of a cerebral air embolus (Fig. 1). An attempt is made to introduce the air into the pleural cavity at a point quite distant from the diseased area so as to lessen the chances of perforating the abscess and soiling the pleura. We have not had a case of empyema directly attributable to a diagnostic pneumothorax.

AMOUNT OF AIR

The amount of air used is governed by the intrapleural pressure, the vital capacity, and the subjective reaction to the air.

Intrapleural Pressure. Intrapleural pressure readings must be taken on these

patients during the diagnostic pneumothorax to prevent, as far as possible, the danger of tearing adhesions and rupturing the abscess into the pleural cavity. The manometer readings keep the surgeon informed as to the intrapleural pressure and serve as a guide to the amount of air that should be used. Whenever a negative intrapleural pressure is shown, air can be introduced with safety. Pressure readings should be rechecked after the introduction of each 25 to 50 c.c. of air, and if the pressures remain negative it is safe to continue. Usually 250 to 300 c.c. of air will be sufficient to give the desired information, but sometimes smaller or slightly larger amounts are required.

There will be no manometer readings if the pleural cavity is completely obliterated by adhesions, and in such instances no air should be introduced.

Vital Capacity. The estimation of the vital capacity is important especially in patients with low vitality. Air must be introduced with caution and in small amounts when the vital capacity is diminished and it should be rechecked several times during the introduction.

Subjective Reaction to the Air. If the patient experiences extreme pain, restlessness, giddiness, shortness of breath, or any other unusual sensation during the induction of the pneumothorax, the procedure should be discontinued immediately regardless of the amount of air that has been introduced.

X-RAY AND FLUOROSCOPY

The needle and cannula are left in place during the fluoroscopic examination and while the roentgen plates are being taken.

* Read before the Surgical Section, California State Medical Society, May, 1930.

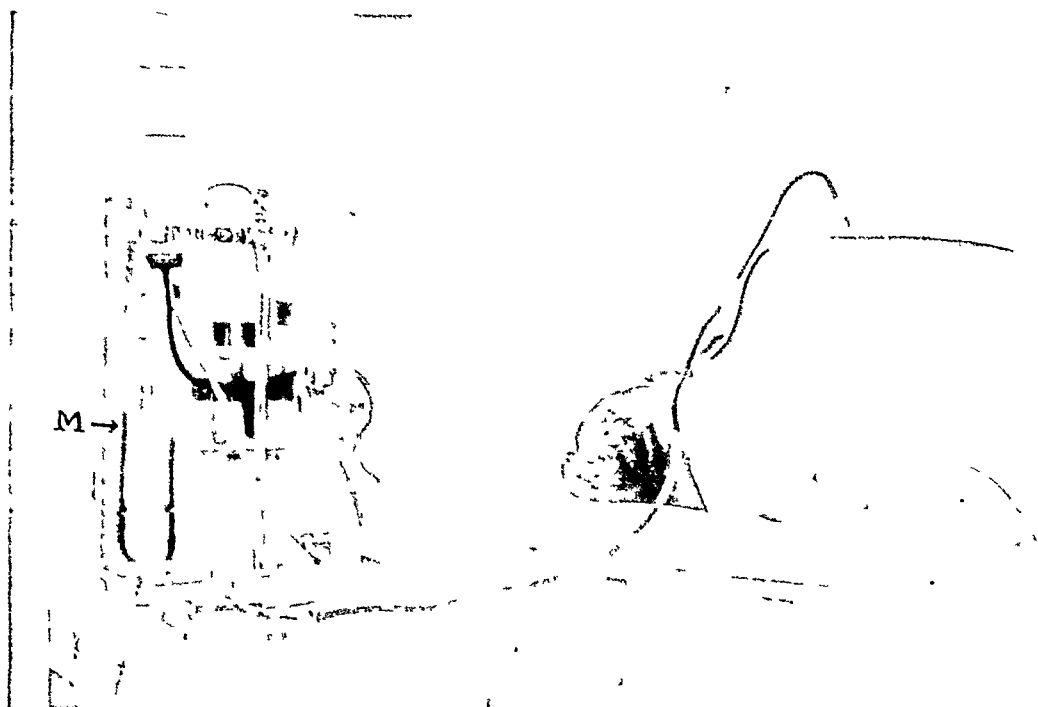


FIG. 1. Position of patient during induction of diagnostic pneumothorax. M, manometer for registration of intrapleural pressures. (We have found the Singer-Phillips pneumothorax machine quite satisfactory for this work.)

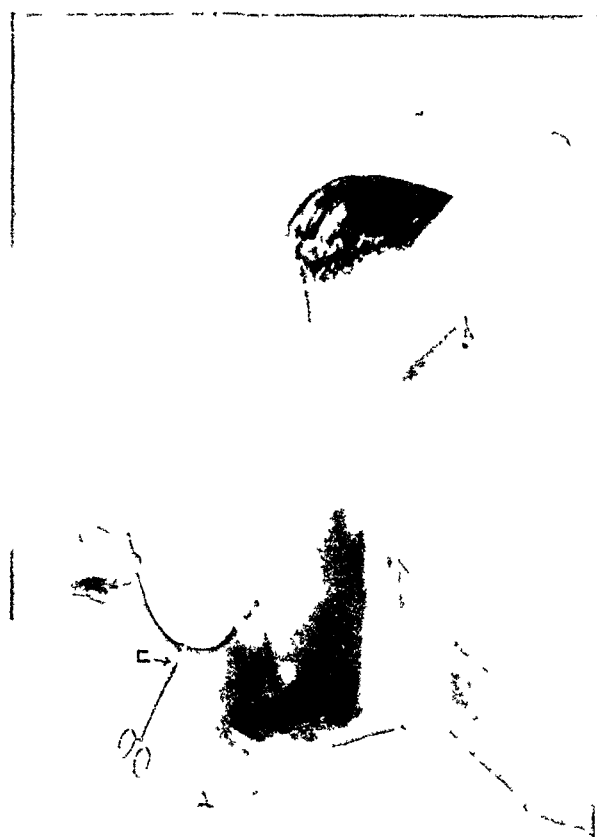


FIG. 2. Needle and cannula in place following pneumothorax. Fluoroscopic and x-ray studies are to be made. c, clamp to prevent escape of air from pleural cavity.

More air may be introduced if necessary and withdrawn at the end of the procedure (Fig. 2).

2. Conservative measures with supplementary minor surgical procedures: avulsion of the phrenic nerve.



FIG. 3. Pulmonary abscess of three months' duration. Arrow indicates mouth of bronchus leading to abscess.



FIG. 4. X-ray study of same patient as Fig. 3. Arrow indicates site of former abscess. Air in pleural cavity demonstrates that the abscess is not adherent to lateral chest wall. Abscess has been compressed and collapsed by pneumothorax. Pneumothorax therefore continued as treatment.

It is advisable to make several roentgenograms; usually three are made in these positions: erect postero-anterior, lateral, and horizontal. The horizontal film is exposed while the patient lies with the affected side uppermost; the film is held against the anterior chest wall while the x-ray tube is placed posteriorly. If the examinations suggest a posterior abscess, the anteroposterior projection is employed to give better definition and more accurate localization of the site and extent of the abscess.

CLINICAL APPLICATION

Diagnostic pneumothorax has enabled us to segregate lung abscess cases into three main groups which respond to the following treatments:

1. Conservative measures: postural drainage, bronchoscopy, and pneumothorax.

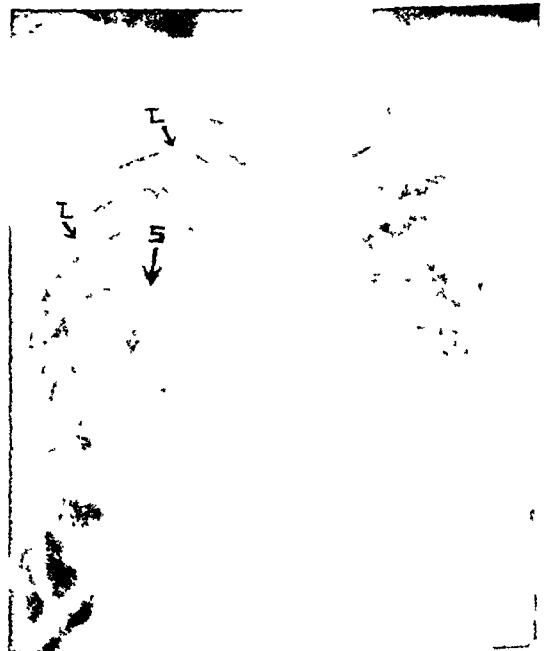


FIG. 5. X-ray study of same patient as Fig. 3. Lung is now reexpanding and patient is free from all symptoms. S, site of former abscess. L, lung edge.

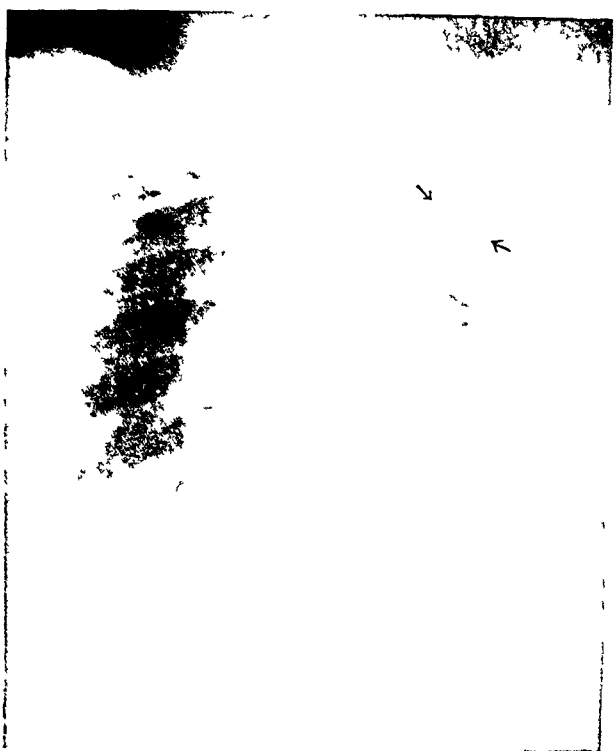


FIG. 6. Pulmonary abscess, left upper lobe, eighteen months' duration. Arrows indicate multiple abscess cavities filled with iodized oil (campiodol).



FIG. 7. X-ray study of same patient as in FIG. 6. Lung edge (L) is adherent to upper lateral chest wall and to diaphragm (D). Inspiratory diaphragmatic movement tugs on abscess and prevents healing. Left phrenic nerve avulsion is indicated to prevent this unfavorable diaphragmatic action, and to permit lung compression and healing of abscess.



FIG. 8. Diagnostic pneumothorax shows that lung is adherent to anterior and posterior portion of diaphragm as well as to upper chest wall. These adhesions hold lung stretched out like a tent and consequently abscess cannot heal. L, lung edge.



FIG. 9. Roentgenogram of same patient as FIG. 8. Phrenic nerve has been avulsed, diaphragm has ascended into thoracic cavity and lung has been compressed.

3. Major surgical procedures: open drainage, cautery-pneumonectomy, partial thoracoplasty, or lobectomy.

should always be preceded by a bronchoscopic treatment and aspiration of the occluding material.



FIG. 10. Left-sided peripheral pulmonary abscess. Iodized oil did not enter abscess. Pneumothorax is to be done to determine presence or absence of adhesions.

If diagnostic pneumothorax demonstrates a pulmonary abscess that is not adherent, a cure may be effected by the combined use of postural drainage, bronchoscopy, and pneumothorax treatments (Figs. 3, 4, 5). The bronchoscopic treatments accomplish and maintain adequate drainage while the pneumothorax evacuates pus from the diseased lung and affords sufficient lung compression and pulmonary rest to permit healing. In these cases pneumothorax has served not only as a diagnostic measure but also as a guide in therapy and as an indication of the probable outcome. Diagnostic pneumothorax should not be used if there is any indication that the abscess has a thin wall. Whenever the bronchus leading to the abscess is occluded, the diagnostic pneumothorax



FIG. 11. Roentgenogram of same patient as Fig. 10 after introduction of air into pleural cavity. Film was exposed with patient lying on his right side. Pneumothorax demonstrates adhesions to overlying lateral chest wall (c-c). Lung is also adherent to medial half of diaphragm (d) but is free elsewhere. Open surgical drainage of abscess is warranted and can be done by a single stage operation because of adhesions. Ribs to be resected clearly indicated (two ribs between c-c). Operation confirmed pneumothorax findings.

Should diagnostic pneumothorax reveal adhesions of the diseased lung to the diaphragm, fluoroscopic examination will determine whether the inspiratory diaphragmatic movements cause a tug on the abscess in such a manner as to prevent healing. This unfavorable tug is present most often when the diseased lung is adherent to a point high in the thoracic cavity and also to the diaphragm. If pneumothorax only is continued as a treatment under such circumstances, the patient may be made worse instead of better. Therefore those who fail to improve with the combined pneumothorax and bronchoscopic treatments should have a phrenic nerve avulsion. This avulsion will relax and elevate the diaphragm, compress the abscess, and prevent the undesirable diaphragmatic tug. Therapeutic pneumothorax may be continued with good results after the phrenic avulsion (Figs. 6, 7, 8, 9).

When pneumothorax shows the abscess situated peripherally and adherent to the chest wall, surgical approach is easy and the study of patients with pulmonary abscesses; it is not our intention to minimize their value.

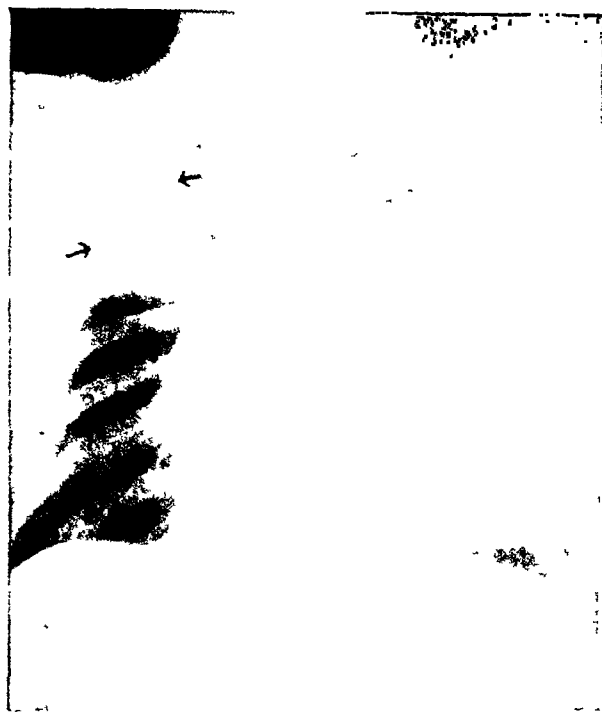


FIG. 12. Pulmonary abscess of right upper lobe, eighteen months' duration. Examinations negative for tuberculosis.

safe and the patient may be offered prospects of a cure by open drainage (Figs. 10, 11).

Patients with chronic lung abscesses, in whom attempted pneumothoraces have demonstrated a complete obliteration of the pleural cavity, are unlikely to be cured by conservative measures. In this group surgery should be done early because delay may lead to a bronchogenic and metastatic spread of the disease. (Figs. 12, 13.)

COMMENT

Pneumothorax is intended to supplement and not to supplant the other accepted procedures. Frequent examinations, plain roentgenograms, iodized oil injections, and bronchoscopic findings, all are important in

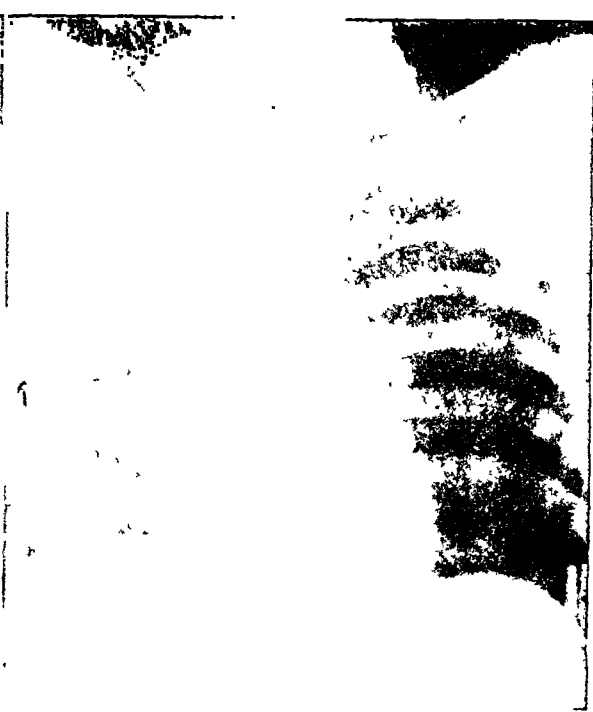


FIG. 13. Roentgenogram of same patient as Fig. 12. Diagnostic pneumothorax shows that pleural cavity is almost completely obliterated by adhesions and that diseased area is firmly adherent to chest wall. Arrow indicates small amount of air outlining lower border of upper lobe. Open surgical drainage is indicated. Operation confirmed diagnostic pneumothorax findings.

CONCLUSIONS

1. Diagnostic pneumothorax has a wide application in thoracic surgery. It is easy to perform and in properly selected cases is rarely followed by complications.

2. The use of this procedure permits early selection of cases that probably will require surgery and allows us to recognize those that likely will get well by conservative measures.

3. The employment of pneumothorax along with bronchoscopy and iodized oil has increased our percentage of cures, has shortened the time of recovery, and has avoided operation in a number of cases.



UNILATERAL IDIOPATHIC HYPERTROPHY OF THE MALE BREAST*

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WINNETKA, ILL.

BAILEY¹ states that up to 1924 but 150 cases of unilateral idiopathic hypertrophy of the breast were on record.

The present case is therefore thought to be of sufficient rarity and interest to warrant report.



FIG. 1.

Patient I. T., aged sixteen, was admitted to the Evanston Hospital on June 11, 1930. The history was negative save for the fact that since about one year previously the patient had been conscious of progressive enlargement of the right breast. When in a swimming suit or engaged in heavy work on shipboard in a track suit, his condition caused him much embarrassment because of the jeering comments of his associates. The physical examination was essentially negative save for the right breast. This was markedly and uniformly enlarged so as to present the appearance of a female breast. The areola was definitely increased in size (see Fig. 1). The consistency of the breast was that of the mammary gland in the female. The genitalia and hair distribution were normal; the voice was deep; the general physical characteristics were strongly masculine.

Because of the embarrassment to the patient a subcutaneous excision of the breast was decided upon. On June 12, 1930, under avertin and nitrous oxide anesthesia a curved incision was made at the inferior lateral border of the breast. The upper margin of the wound was reflected backward and breast dissected away from the skin and pectoralis major muscle until it was entirely excised. Aside from the necessity of evacuating a serous collection from beneath the skin, the patient made a very satisfactory recovery.

¹ Bailey, H. *Lancet*, 1:1258, 1924.

* Submitted for publication April 30, 1931.



THE EFFECT OF AVERTIN UPON THE NORMAL AND IMPAIRED LIVER*

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AVERTIN, tribromomethylalcohol, was first used as a general anesthetic in 1926 in Germany. It immediately claimed extensive attention in that country; the bibliography of the monograph of Anschütz, Specht and Tiemann¹ published last year, covers ten pages. Much for and much against the new compound has been published but there would seem to be little doubt now that the substance has found a definite field of use among the anesthetics.

There is a considerable degree of chemical relationship between chloroform and avertin; the former contains three atoms of chlorine, the latter three atoms of bromine; one is a methane derivative, the other an ethyl alcohol derivative. Because of the halogen content, by analogy with chloroform, it was natural that the question of possible liver damage from avertin arose; chloroform as is well known, is very toxic to this organ. While the question is a legitimate one, investigation alone and not presumption can furnish the answer. One of us in collaboration with M. Bruger and N. B. Dreyer has already published the results of experiments on the effect of avertin upon hepatic function in normal men and dogs.² These results indicated that the action of avertin upon the normal liver is practically negligible, about the same as in the case of ether and much less than in the case of chloroform.

It is a matter of importance to know whether an organism with an already subnormal liver withstands avertin as well as a normal one. Increased susceptibility might be due to one or two things. First there is the possibility of greater interference with liver functions than in the normal animal. And second, since avertin

is excreted as a conjugated glycuronate, the question of interference with the detoxification of avertin arises. If the conjugation process took place less completely or readily in an organism with a pathological liver, assuming that the process in question occurred in the liver, the action of avertin in other tissues might be more prolonged or more severe. However, Eichholtz³ has reported that when the liver is injured by ethylene chlorhydrin the detoxification of avertin proceeds normally; this organ would not appear, therefore, to be the only tissue concerned in the conjugation process and any deleterious action of avertin upon it must be confined to interference with other liver functions. So far as these are concerned, we have noted the work of Kaczander⁴ only, who could find no evidence of a toxic action upon the liver cells as tested by the effect of the administration of galactose upon the bilirubin content of the blood.

Waters and Muehlberger⁵ in their work upon avertin report the histological findings in the livers of three dogs which had received from eight to twenty rectal injections of avertin every two to five days. "The liver parenchyma showed marked swelling of the cells which almost obliterated the capillary field. The individual cells were extremely pale and vacuolated, and showed coagulated, eosin-staining granules throughout. The vacuoles were serous rather than fatty. In one case the cells were distinctly atrophic." On gross examination the liver presented possible fat. The question whether such changes would have been observed following a single administration of avertin is not answered by these observations.

* Submitted for publication September 30, 1931.

Deaths in man following the use of avertin have in some cases been attributed to liver damage. Anschütz, Specht and Tiemann discuss some of these cases in their review and suggest that data similar to those in avertin literature might be obtained if one looked as diligently for liver damage after ether or even local anesthesia.

This communication represents efforts (a) to detect histological changes following avertin in dogs which had had repeated administration of avertin (similar experiments to those of Waters and Muehlberger) and (b) to measure the action of avertin upon the liver function in dogs in which this had been depressed by previously subjecting the animals to chloroform anesthesia.

EXPERIMENTAL

1. *Histological.** Histological examinations of the liver were made in five normal dogs and of the kidneys and heart in three which had previously received from three to six full anesthetic doses of avertin fluid per rectum (0.5 grams of avertin crystals per kilogram of body weight), in the course of one week. Frozen sections were used for the detection of any possible fatty changes.

Of these animals one was in the early stage of pregnancy and another at term, delivering itself of a normal litter of pups during the experiments. It is of interest to note here that the length of anesthesia in these two animals was greatly prolonged, due possibly to the fact that in calculating the dosage of avertin, no allowance was made for the gravid uterus and its contents and to the altered condition of the liver during pregnancy. As will be shown later in this communication, anesthesia is prolonged in animals with damaged livers.

The following is a summary of the histological findings:

Liver: The most consistent change is the presence of swollen parenchymal cells compressing the intercolumnar spaces, with vacuolization of the cytoplasm, (a parenchymatous degeneration compatible with restitution to

normal function). The livers of the two pregnant dogs both showed slight fatty changes; in one there was a slight fatty degeneration, in the other a slight fatty infiltration. Of the other three animals, one revealed the presence of a slight fatty degeneration while the remaining two presented no fatty changes at all.

Kidneys: In one instance there was a slight parenchymatous and fatty degeneration; in another, a moderate similar condition and in the third, a dilatation and engorgement of the large vessels.

Heart: Normal in all cases.

These findings confirm those of Waters and Muehlberger⁵ Eichholtz states that avertin causes no "Leberverfettung."⁶ The histological picture presented here is not at all typical of a chloroform-like action.

2. *Functional:* The effect of avertin upon the liver function was measured by means of the bromsulphalein test according to Rosenthal and White.⁷

As controls, three normal dogs were given 0.5 c.c. of avertin fluid in a 3 per cent aqueous solution per rectum. Twenty-four hours later the liver function was measured by determining the percentage of dye retained in the blood, fifteen minutes after its intravenous injection. In all 3 cases the retention was not more than 5 per cent. Forty-eight hours later there was no fifteen-minute dye retention. Among our previously published results embracing a large series are some showing higher degrees of impairment. The difference, if the present three results represent a difference rather than a fortuitous circumstance, may be due to the fact that in these later experiments the avertin was administered very slowly. Slow administration was found to result in smoother induction with less cyanosis.⁸

Chloroform was then administered by inhalation to seventeen normal dogs in which a control liver function test had been performed; the duration of administration was varied from fifteen minutes to one hour in order to produce different degrees of liver damage, though even in experiments in which the chloroform periods were equal, quite different degrees of functional disturbances may result. The degree of liver damage under these conditions and the curve of restitution to normal function have been worked out previously in this laboratory.⁹

After periods varying from one to six days after the chloroform administration (in order to observe its effect on liver function at differ-

*The authors are indebted to Dr. Bowie of the Department of Histology for the preparation of the sections and to Prof. T. R. Waugh of the Department of Pathology for examining them.

ent stages of liver damage), full anesthetic doses of avertin fluid were administered, and liver function was again determined. The data

words, the decrease in liver function due to the avertin, is from 20 to 30 per cent. In the earlier work referred to here, this

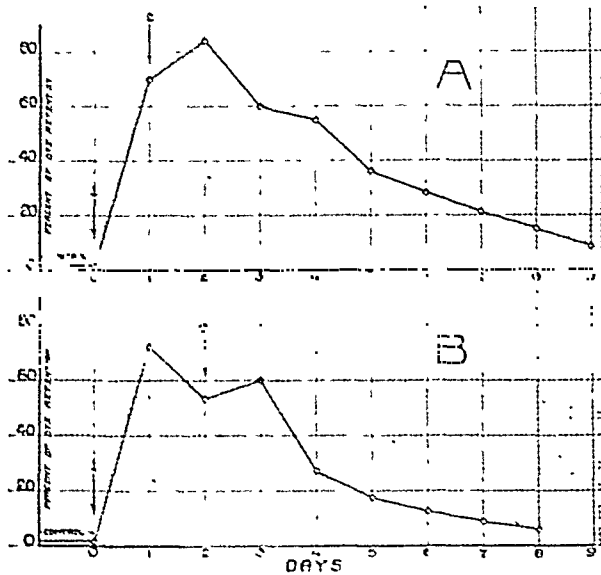


FIG. 1.

also make it possible to observe the effect of avertin on the duration of the liver damage due to chloroform.

Figure 1 (A) represents the composite of three curves obtained by plotting the percentage of dye retention fifteen minutes after its injection in three experiments in which the chloroform had been administered for a half hour and in which the liver damage was relatively severe. At 1 the chloroform was administered (immediately after the control dye test); at 2, twenty-four hours afterwards, avertin fluid 0.5 c.c. per kilogram of bodyweight, was injected rectally (immediately after the second dye test). Curve 1 B is a similar composite of three other experiments in which the avertin was given forty-eight hours after the chloroform administration.

These curves show that the additional impairment of liver function superimposed upon that already present is probably somewhat higher than that produced by avertin in the normal animal (5 per cent as stated previously) but that the return to practically complete normal function is not appreciably prolonged.⁹ The average increase in dye retention, or in other

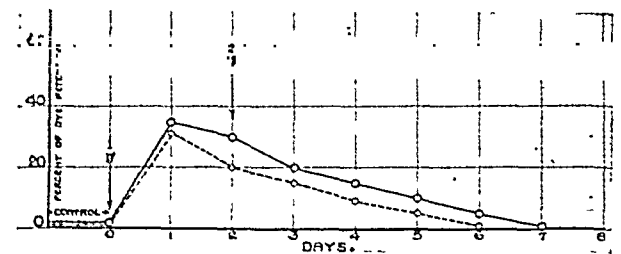


FIG. 2.

degree of dye retention was observed only occasionally.

The effect of avertin on liver function in livers only moderately damaged (fifteen minutes of chloroform) is shown in Figure 2. The broken and unbroken lines represent two separate experiments in which chloroform was administered for fifteen minutes (1), followed in forty-eight hours by avertin (2). It will be seen from this chart that avertin under these conditions has very little effect on liver function. In another experiment (not shown), in which the liver damage had been more severe, the avertin was administered on the sixth day following the chloroform (fifteen minute administration). When the avertin was given, the liver function had returned to approximately the same level as in Figure 2 at the second day. The result was identical with those obtained in the other experiments, i.e., there was little if any effect on the liver function or on the curve of recovery.

Figure 3 (A and B) shows the curves obtained when, after severe liver damage had been produced by chloroform inhalation (fifteen minutes) at 1 in the chart, avertin was given at a time when the animals showed all the evidence of delayed chloroform poisoning (four to six days after chloroform administration). In Figure 3 A, even under these circumstances, the deviation from the normal course of recovery is comparatively small and almost imperceptible clinically. This curve is typical of three similar experiments.

In two other experiments of this kind, Figure 3 B, death occurred during the administration of the avertin. Both animals

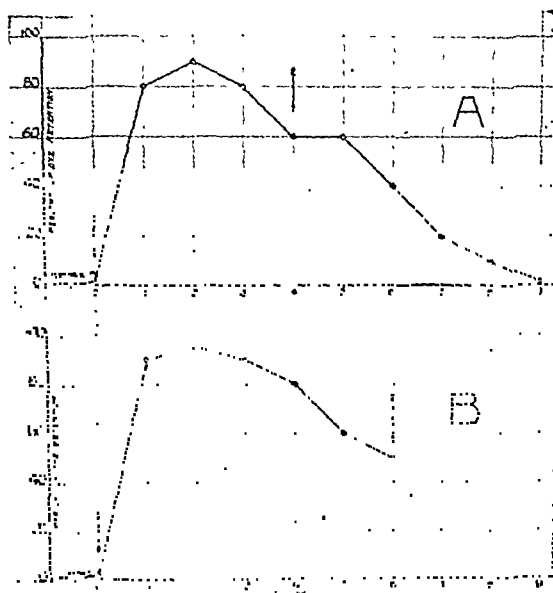


FIG. 3.

were in perceptibly subnormal condition before the avertin was injected. While to avertin must be attributed the immediate cause of death, the fact that death occurred so soon after the avertin was given, diminishes the likelihood of its being due directly to the action of avertin upon the liver. The animals would probably have succumbed to ether or to almost any additional strain because of poor physiological condition generally.

In one experiment in which severe liver damage was caused by the inhalation of chloroform for one hour, the administration of avertin forty-eight hours later produced an increase from 70 per cent to 95 per cent fifteen minute dye retention which lasted for slightly over two days. The liver function returned to normal (no dye retention in fifteen minutes) fourteen days after exposure to chloroform. This is well within the lower limits of recovery for the initial degree of liver damage observed by Rosenthal and one of us.⁹

It has been observed throughout these experiments that with the same dose of avertin, the anesthesia is deeper and lasts

longer in dogs with impaired livers than it does in normal animals.⁸ It would seem desirable therefore, to reduce the dose of avertin in individuals with impaired livers.

SUMMARY AND CONCLUSIONS

1. Repeated administration of avertin in normal dogs produces only a mild parenchymatous degeneration of the liver and kidneys.
2. Fatty changes in the liver occur occasionally. When they do occur, they are very slight.
3. No histological changes occur in the heart following repeated avertin anesthesia.
4. Avertin produces from 5 to 30 per cent additional damage to liver function; this additional damage varies in proportion to the severity of damage previously produced by chloroform. This added liver damage disappears within twenty-four to forty-eight hours and does not affect the total period of recovery from chloroform poisoning. In the normal animal (not poisoned with chloroform) avertin produces somewhat less impairment of liver function.
5. Avertin has by no means the same damaging effect upon the liver as chloroform.

6. Avertin can probably be used quite safely in individuals with moderate liver damage, though it is perhaps advisable to use a smaller dosage.

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THE CLINICAL MANAGEMENT OF HORSESHOE KIDNEY*

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NEW YORK

Part I†

I. INTRODUCTION

HORSESHOE kidney or fusion of the two kidneys across the mid-line of the body by an isthmus, is, after double kidney and reduplication of pelves, the most common of all renal anomalies.

The anatomical conception of this congenital malformation has been well established since the early days of observations on the cadaver. Its frequency and the associated pathology as well as the concomitant anomalies and the predisposing urinary stasis and various diseases have also been described by many authors who have written on the subject. Even during the last half century with the beginning of renal surgery, this "rare curiosity" of the ancient days was quite frequently found by the surgeon at operation. Moreover, before a clear-cut clinical diagnosis was ever possible, surgical intervention upon this fused organ was advocated. However, not until comparatively recent years has the surgical importance of this pathological entity been recognized, and it is due mainly to the advantages of the urographic era that accuracy and perfection in the operative diagnosis of the horseshoe kidney disease have become possible.

I shall therefore endeavor briefly to discuss the value of its preoperative diagnosis and its clinical management, and to bring to view what should be the proper treatment of this urological condition.

It is also my purpose to point out the importance of a new clinical entity which, although it has been recently described, has not been given sufficient attention and has apparently not received enough emphasis or recognition, namely, "disease of the horseshoe kidney"

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or "horseshoe kidney disease," particularly when there is no association of a concomitant disease or any evidence of gross pathology present in the fused organ. When the horseshoe syndrome of clinical manifestations is due to the prominent position across the midline which the anomalous kidney occupies—pressing upon the great abdominal vessels, the aorta and vena cava, the thoracic duct, the solar plexus with its splanchnic, pneumogastric and phrenic nerves, the lumboaortic plexus and the sympathetic and parasympathetic nerves which run alongside the midline—this pressure constitutes a sufficient cause for the long-standing complaint, which is expressed clinically in intermittent attacks of indefinite abdominal pain referred to the epigastrium or the umbilical region, or in pain across the lower back, commonly accompanied by marked chronic constipation and sometimes by gastrointestinal disorders, and later by urinary disturbances, for which the patients are referred to the urologist for examination.

Furthermore, it is an entity which deserves painstaking attention with regard not only to the diagnosis, which is nowadays urologically well recognized, but also to the method of treatment, which obviously should be, first, medical, second, urological, and third, surgical. I wish here to stress the surgical aspect, because in many instances no permanent cure or relief of symptoms can be obtained without the surgical division of the isthmus by a symphysiotomy procedure, such as was described by Rovsing in 1911, and later practiced and advocated by Papin, Martinow, Kroisz, Van Houtum and Frank Kidd as the most logical and as the anatomico-physiological method, relieving the pain and pressure caused by the constant tension of the renal isthmus upon the organs of the blood, nerve and lymphatic supply which run perpendicularly alongside the lumbar column and upon which the undivided isthmus of the horseshoe kidney makes pressure by its weight.

Although it appears that normal horseshoe kidneys do exist and are found at autopsy or in the dissecting room, we cannot overlook the fact that potentially all individuals who have been born with horseshoe kidney and who come to us for examination come because they are suffering with some chronic renal disease due mainly to the unusual and abnormal position of the fused organ and its excretory apparatus.

Many operations upon the horseshoe kidney have been practiced in America as well as abroad, but so far as the records and literature are concerned I have not been able to find a single instance in which this conservative procedure has ever been performed on this side of the world. I hope, therefore, that this present study will serve to stimulate attention to the consideration and discussion of the value and also the convenience of this method of treatment in horseshoe kidney disease.

It has been my good fortune, after the study of my own personal observations, to review the cases seen in the last ten years at the Urological Department of the James Buchanan Brady Foundation of the New York Hospital where 25 cases of horseshoe kidney have been observed. Of this series of cases which I am reporting, 4 were found at post mortem, 2 were diagnosed at operation and 19 were diagnosed urologically and urographically previous to operation.

All of the 25 clinical observations have revealed much unknown and unsuspected pathology and have been of great clinical value as the basis of this study.

I am indebted to Dr. O. S. Lowsley, the Director of the Urological Department of the New York Hospital, and to the members of the staff of that institution for having permitted me to use their cases for this presentation.

II. CLASSIFICATION

From the anatomical standpoint as well as from that of the pathological and clinical management, it is important to establish at the outset a classification that may serve to comprise not only the different types and forms of this anomaly but also to summarize more clearly and comprehensively the different aspects of the clinical conception of the horseshoe kidney.

In Figures 2 and 3 I have tabulated in a graphic manner the different types of this renal anomaly as collected from the various authors who have written on this subject.

But horseshoe kidney classically must be divided, for its better clinical and surgical management, as Gerard has proposed, into two essential groups, namely, the symmetric and the asymmetric. The first group comprises 2 types. (1) those cases in which the fusion of

the two organs is made by the lower pole of the two kidneys forming a semicircular bridge of renal parenchyma with the concavity above, and (2) those in which the fusion is made by the union of the upper

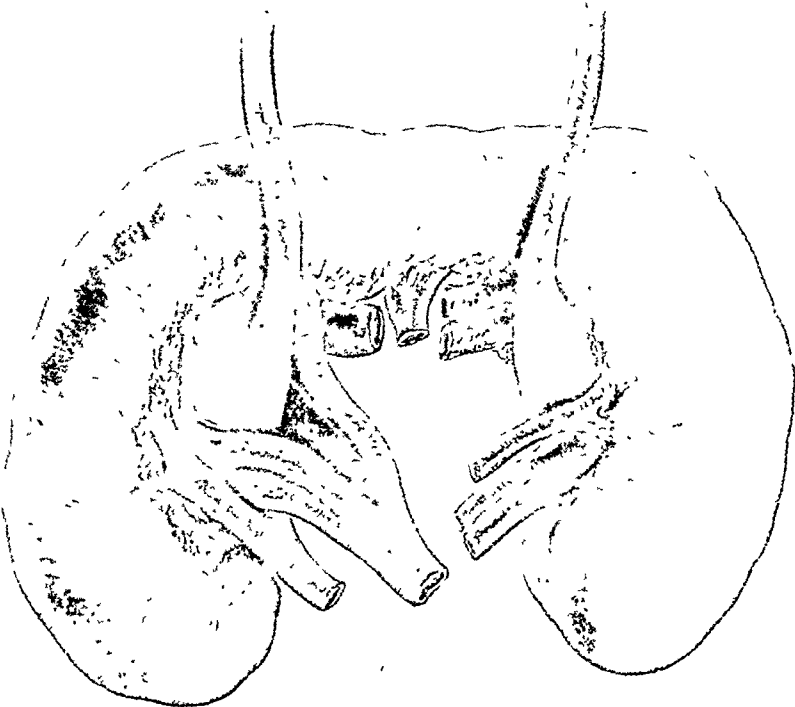


Fig. 1. Horseshoe kidney drawn from autopsy specimen of Case xxvii. Notice the extreme multiplicity of the blood supply and the typical ventral position of the pelves and ureters, as is the rule in the symmetric type of horseshoe kidney disease.

pole of the kidneys, with the concavity below. In both instances the fused organ sits, like a body on horseback, on the spinal column at about the level of the third and fourth lumbar vertebrae, with an upper or lower angle in the shape of a U or V, with all the characteristics of a horseshoe, from which this rare anomaly takes its name. As a rule the isthmus is of true renal parenchyma and is seldom a band of fibrous tissue. The pelvis of the kidney is anterior to the blood supply of the organ, and the ureters run in front and at times perpendicular to the isthmus of the fused organ, and therefore parallel to the vertebral column and median line (see Figs. 1 and 2).

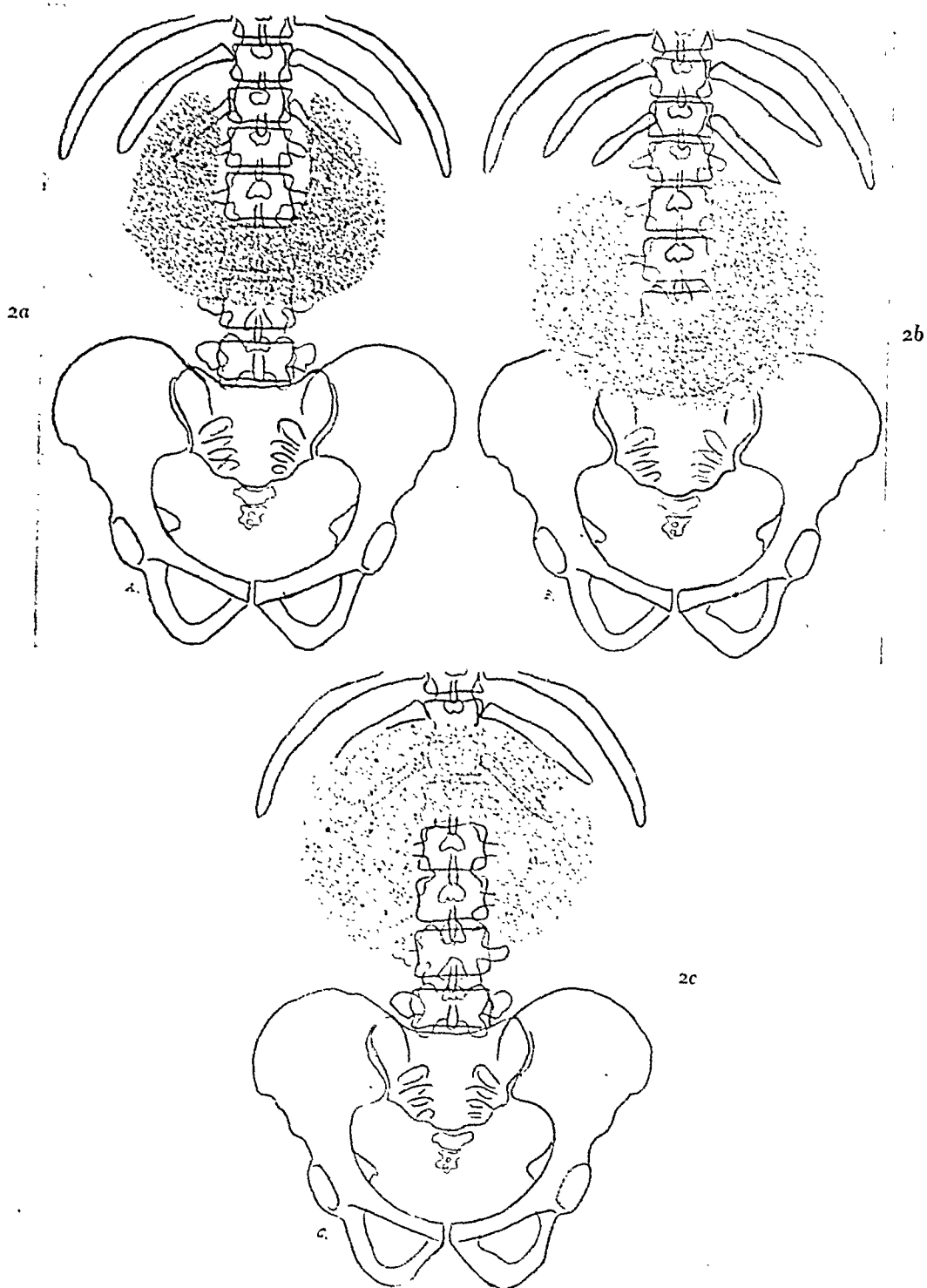
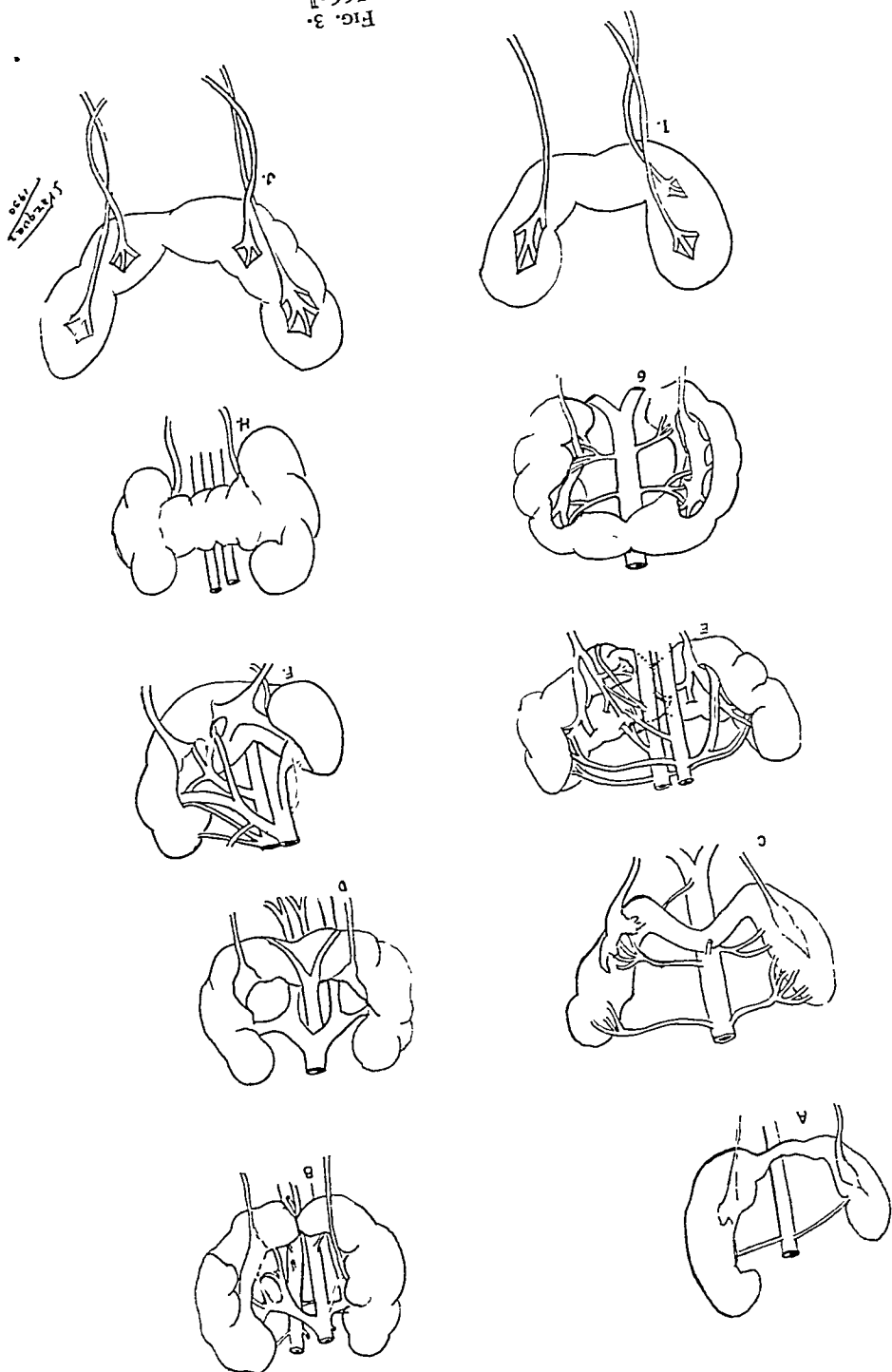


FIG. 2, *a*, *b*, and *c* illustrate the forms and positions most commonly observed in horseshoe kidney disease. *a* and *b* represent the two most common types and positions of the symmetric horseshoe kidney as found in this series of cases, while *c* is the more rare instance, in which fusion of the two halves occurs by the upper pole with the concavity facing downward as in Case xxv.

Fig. 3.
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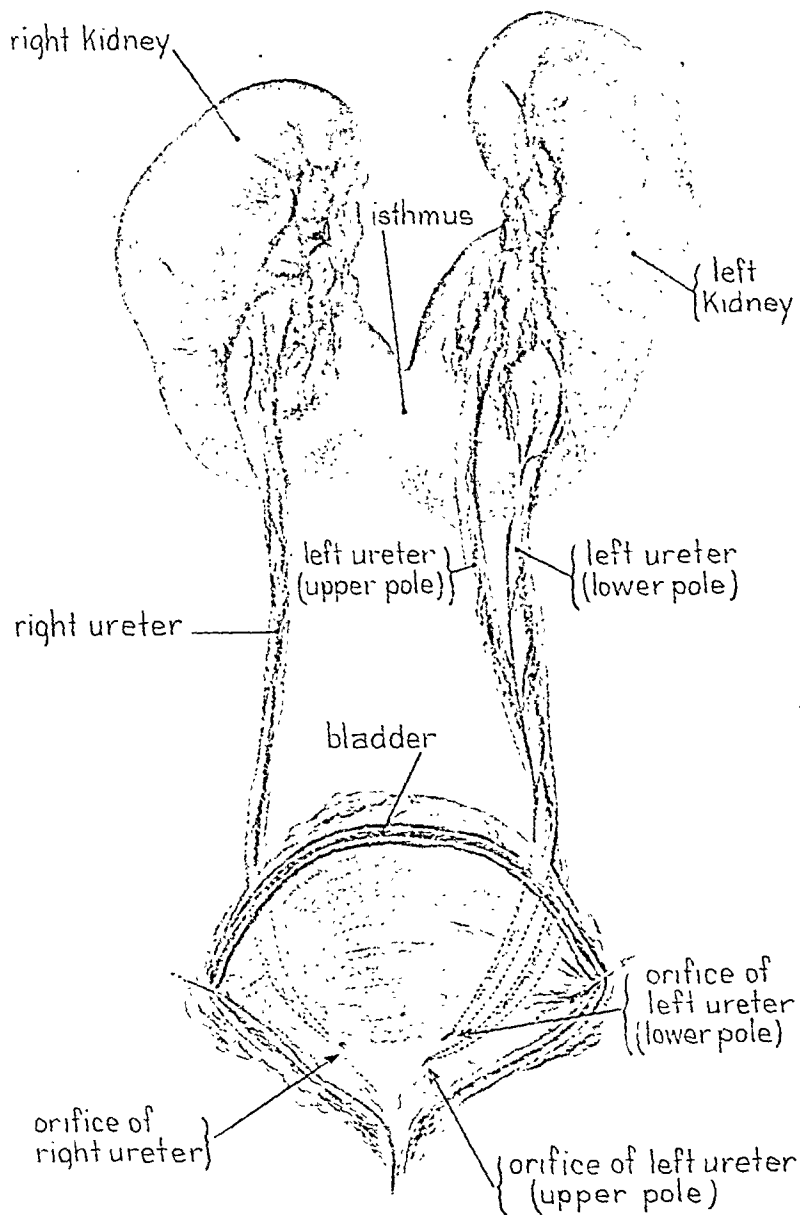
This is the true type of horseshoe kidney and the one more commonly known, which I shall discuss in this presentation. In this series of 25 cases of the symmetric or uniform type, the fusion in 24 was made by the lower pole, consequently with the concavity facing upward, while in only one of the cases did the fusion prove to be at the upper pole, representing quite a rare instance, which was found in the specimen removed at post mortem (see Fig. 5).

The second or asymmetric type of fused kidney, where the fusion of the two organs adopts an anatomically different form, with regard to shape, location and position, is more rarely seen and must of necessity be described under special types of renal fusion. According to the form they adopt they are called unilateral fused kidney, L-shaped renal fusion, fusion en galette or disk form, sigmoid fusion, fusion en masse and fusion without form, all of these rare types being generally unions of ectopic kidneys, placed low in the bony pelvis or located at one or either side of the vertebral column. These varieties of fused kidney and crossed ectopic kidneys deserve painstaking attention, and I will reserve discussion of them for another communication on asymmetric renal fusion.

Undoubtedly the frequency with which horseshoe kidney is diagnosed in vivo will markedly increase as time goes on, due mainly to the urographic era of diagnosis. Before the era of pyelography the rate in autopsy findings was about 1 in 1000, while in the last

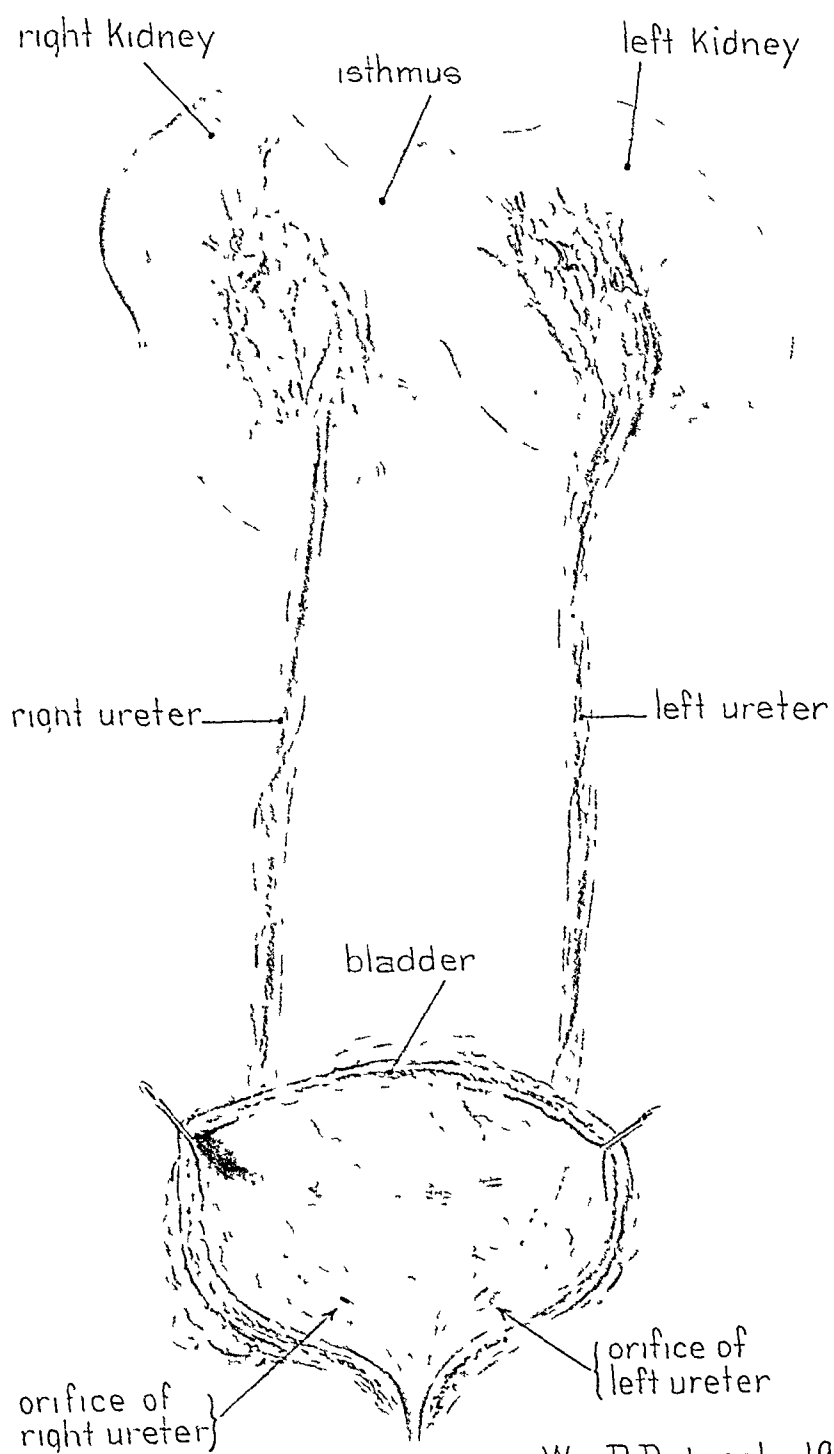
FIG. 3. Represents the different types of horseshoe kidney as they have been collected from the literature.

- A. Fusion of the two lower poles by a thin membranous tissue running across the midline.
- B. The fusion of the two organs is by contiguity of the two lower poles by a fibrous tissue situated in front of the aorta and vena cava.
- C. The union of the two organs is made by a narrow band of parenchymal renal substance constituting the isthmus of the horseshoe kidney.
- D. The fusion of the two organs is made by a true gross isthmus of renal parenchyma which appears to be the most common type on record and the one most frequently observed clinically.
- E. Shows the very rare instance in which the isthmus of the fused organ lies behind the great abdominal vessels.
- F. The fusion is of the asymmetric type where one-half of the fused organ is larger than the other, and one pelvis lies in the middle portion of the renal isthmus.
- G. The isthmus of the fused organ is formed by the union of the two upper poles with the concavity facing downward.
- H. The fusion of the two organs is made by a band of renal substance at the middle portion of the organ, forming the shape of a letter H.
- I. Represents the typical symmetric type of horseshoe kidney with unilateral duplication of pelves and ureters.
- J. Horseshoe kidney with bilateral duplication of pelves and ureters.



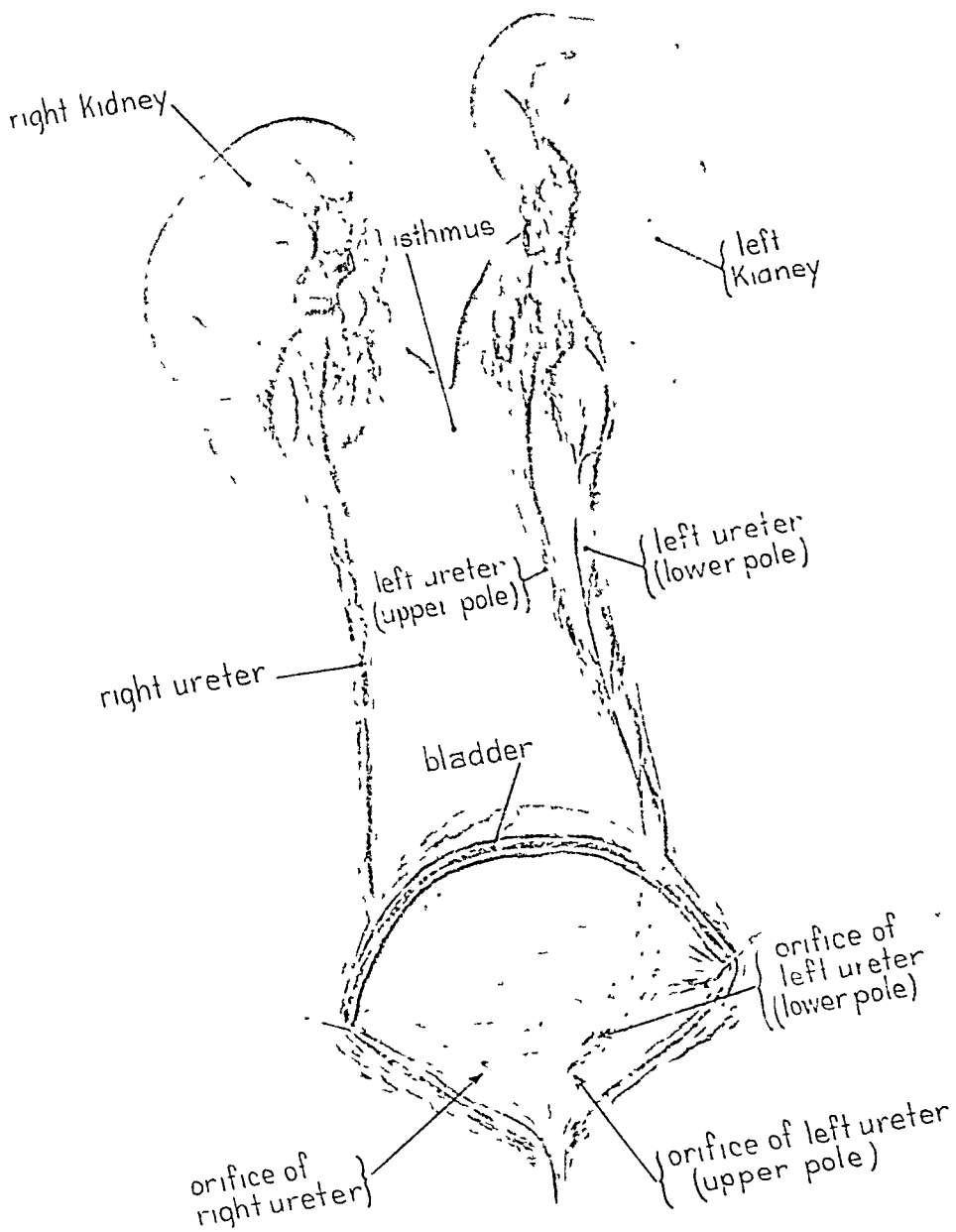
Wm. P. Didusch 1930

FIG. 4. Drawing from post-mortem specimen of Case xxiv representing a horseshoe kidney with fetal lobulations of the anterior surface, and with double pelvis and ureters on the left side, opening normally into the urinary bladder. This patient was a man thirty-five years of age and the autopsy disclosed a retroperitoneal lymphosarcoma involving the anatomic structure surrounding the horseshoe kidney.



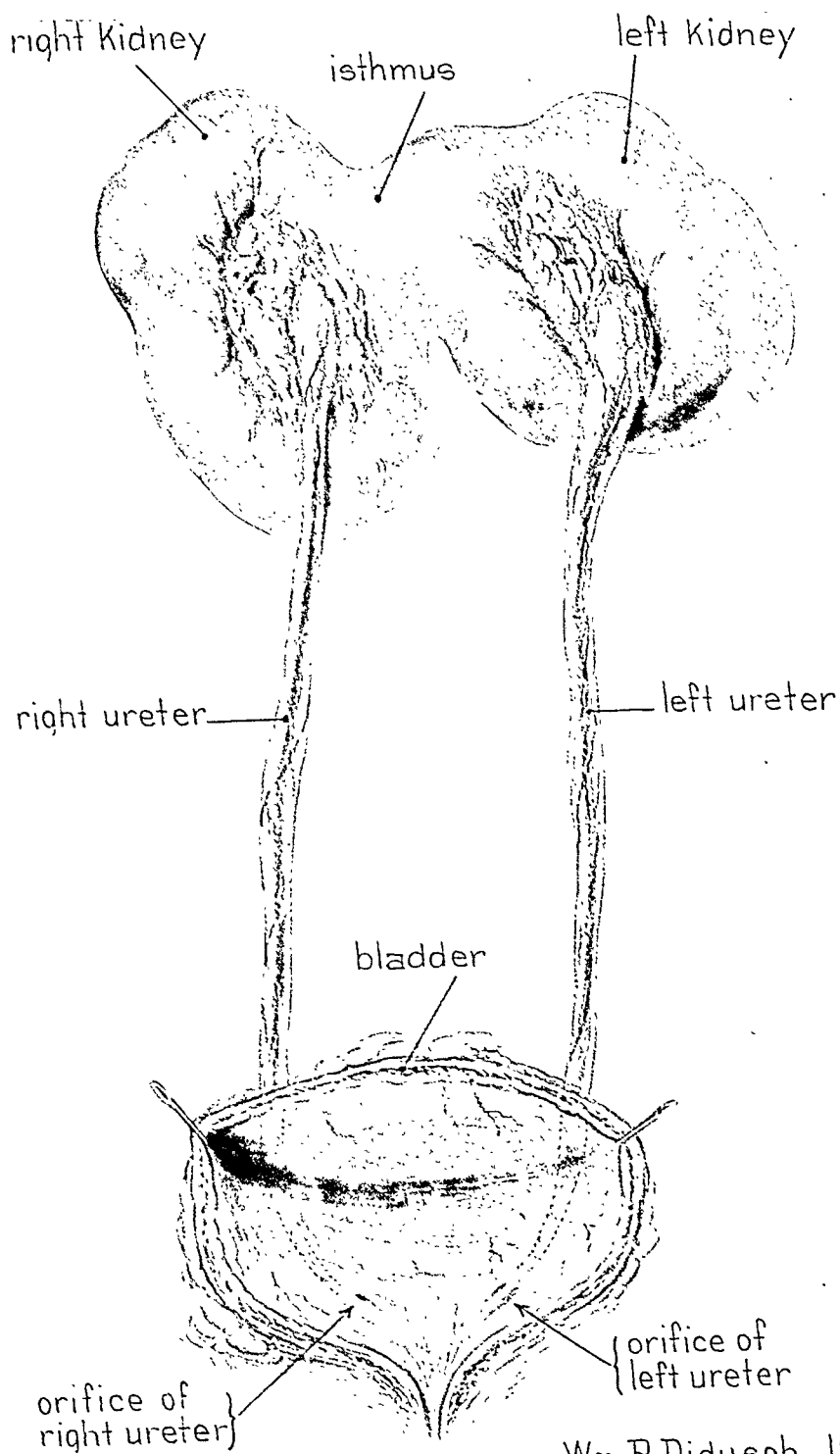
Wm P Didusch 1930

FIG. 5.
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Wm. P. Didusch 1930

FIG. 4. Drawing from post-mortem specimen of Case xxiv representing a horseshoe kidney with fetal lobulations of the anterior surface, and with double pelvis and ureters on the left side, opening normally into the urinary bladder. This patient was a man thirty-five years of age and the autopsy disclosed a retroperitoneal lymphosarcoma involving the anatomic structure surrounding the horseshoe kidney.



Wm. P. Didusch 1930

FIG. 5.
[665]

two decades with systematic urographic examination it has increased in vivo to about 1 in 400. Hence it is very important to classify these renal anomalies finally into two great categories, namely the normal horseshoe kidney with clinical symptoms and the pathological horseshoe kidney with associated lesions, both of which clinical entities I shall describe collectively as the horseshoe kidney disease.

III. HISTORY AND LITERATURE

The history of the horseshoe kidney is as ancient as creation itself, since it has its very origin in an embryological congenital malformation found from the earliest days of medicine and anatomical sections in cadavers. The literature of this subject is so extensive and the names of authors who have written on it are so numerous, that it is beyond the scope of this presentation to discuss them in detail or even to mention all of them by name.

However, in modern days of medical science, marked especially by the continuous progress made, it is possible to divide the historical aspect of this study into three distinct eras.

The first era comprises the early days of medicine and cadaveric observation when horseshoe kidneys were found only at post mortem, and the malformation was regarded merely as a "rare anatomical curiosity" without clinical or true pathological significance. Among the first to mention such cases was Berengari da Carpi in the year 1522, and later we find in this connection the names of Morgagni, Cruveilhier, Bartholin, Bellini and other early anatomists. But it is to Morgagni that the credit belongs for the first anatomical description of horseshoe kidney, as well as for the physiological observation of the associated pathology often resulting from the lack of mobility and from the pressure which the anomalous viscus exerts upon the organs of the circulation. Rayer also wrote upon the subject and illustrated it well in his remarkable atlas published in 1837 in which he also called attention to the degree of fixation and compres-

FIG. 5. Drawing from autopsy specimen of Case xxv, representing the very rare instance of renal fusion made near the upper pole by a true isthmus of renal parenchyma, lying in front of and across the great abdominal vessels. The pelves are of intrarenal type and are anteriorly situated. The ureters, therefore, run down from the upper portion of the organ and interfere with the physiologic dynamic function of the excretory apparatus. The two ureters open normally into the bladder. Patient was a woman of fifty and while the direct cause of death was undetermined, it appears that the pressure, tension and fixation of the organ upon the great vessels produced an aneurysm of the arch of the aorta and hence were possibly the direct cause of death.

sion of the renal mass upon the abdominal vessels, producing in some instances aortic aneurysm, cardiac hypertrophy, thrombosis of the iliac veins, and sometimes causing ascites and edema of the extremities for lack of circulation. In those early days all the observations were drawn from autopsy specimens and studies on the cadaver. In fact all cases were considered as rare curiosities or anatomical monstrosities, with the most mysterious and enigmatic elements predominating in the situation.

The second period dates from the beginning of renal surgery, about half a century ago, when horseshoe kidneys were accidentally discovered and diagnosed at operation during an exploratory laparotomy procedure for an undetermined abdominal tumor. In such cases the surgeon had to close and finish the operation without the accomplishment of any beneficial result to the patient, and without any surgical attempt upon the anomalous fused organ being ever considered feasible, owing mainly to lack of diagnosis and proper technique and to the potential risk of undertaking a surgical impossibility. Moreover, during this period much confusion existed, due mainly to the unclassified types of cases reported in the literature and to errors and misleading diagnoses, certain authors having mentioned a few instances in which a fused ectopic unilateral kidney was mistaken for an abdominal tumor and removed, with consequent anuria and death.

The third period may be divided into two essential parts. First, we have the era of clinical diagnosis, when operations upon the horseshoe kidney were performed. In thin patients the diagnosis was made on physical examination by deep palpation of the isthmus of the horseshoe organ across the midline of the vertebral column, with due consideration of the clinical manifestation and the concomitant pathology present in the fused kidney. Among the first successful surgical cases reported are those of Israel, Rumpel, Kuster, Newman, Kumwell, Rovsing and Albarran, when various operations, including nephrolithotomy, pyelolithotomy and heminephrectomy on the horseshoe kidney, appeared to be successfully performed. Secondly, we find the era of accuracy in diagnosis, starting at the beginning of the 20th century with the introduction of the roentgen rays and urography, which with the aid of cystoscopy, catheterization of the ureters and renal functional tests inaugurated

the most accurate and brilliant period of the preoperative diagnosis of this most important urological condition.

Hence, the historical aspect can be summarized by saying that the hazardous days of the ancients who, without clinical means of recognition, were confronted by the most enigmatic and difficult situations, have given place to an era of urographic perfection in diagnostic methods, an era which has at the same time introduced new urological treatments and the clear-cut possibility of conservative surgery upon the horseshoe kidney. Among the most important contributions made during the last three decades was that of Israel who, in 1900, was the first to call attention to the possibility of preoperative diagnosis of horseshoe kidney by careful abdominal palpation, provided that the surgeon has in mind such an anomaly. Albarran in those days also successfully performed heminephrectomy and ureteropyeloplasty for hydronephrosis in horseshoe kidney. Martinow on March 9, 1909, was the first to divide the isthmus in order to separate the fused kidney. Rovsing in June 17, 1910, described in full the technique of the new operation for symphysiotomy in horseshoe kidney. He reported a successful case and advocated the use of the method even in the normal horseshoe kidney, recommending the transperitoneal route of approach by the midline of incision as in laparotomy. This operation, however, in view of its many difficulties and lack of proper indications, did not achieve popularity. It presented the disadvantages of uncontrollable bleeding, lack of exposure, danger of secondary infection, urinary fistula and peritonitis, with consequent high mortality. For this reason it has not been performed in European clinics more than a dozen times until within recent years, when Papin introduced a modified technique that made its successful performance possible.

However, before the real value of pyelography was fully recognized and the procedure came into regular vogue, many other contributions of clinical and surgical importance were published. Biron for example, studying the clinical significance of this anomaly in 1909, stated that horseshoe kidney without pathological lesions may be spontaneously painful, owing mainly to lack of mobility and relative fixation. Also Carlier and Gerard, in 1912, reviewing the surgical anatomy of the "*rein en fer à cheval*" pointed out that the

symptoms and signs in horseshoe kidney are different from the pain in renal lithiasis or ureteral lithiasis. At the same time they quoted the criterion of Morgagni regarding the immobility and the compression exerted by the renal isthmus upon the abdominal vessels, as a causative factor in the pain and lack of circulation, producing in certain instances thrombosis of the iliac veins with edema of the extremities, and sometimes cyanosis and ascites. They also observed that it interfered with the general circulation, causing cardiac hypertrophy and, among the earliest symptoms, tiresome lack of respiration, general anemia, indefinite abdominal pain and marked chronic constipation. Legueu and Papin, in reporting 10 cases found at post mortem, made a survey of the literature from which they collected 212 observations, making a total of 222 cases reviewed. Beyer, in studying 262 cases from the literature, found that the fusion of the upper poles occurred in 18 instances. Botez in 1912 in an exhaustive review of the literature found 5 cases of tumors of horseshoe kidney in children, 4 of which were sarcoma involving one-half of the kidney while the other was a case of carcinoma. He collected from the literature 320 cases, among which he described the following pathological lesions found in horseshoe kidney: 17 cases of lithiasis, 16 of bacillosis, 15 of hydronephrosis, 4 of pyonephrosis, 6 of cyst, 2 of polycystic kidney, 2 of nephritis and 6 of tuberculosis. He concluded that 52 of the patients were incapacitated as a result of the renal condition, and that the ideal treatment in normal horseshoe kidney is the complete division of the isthmus as soon as the diagnosis can be made.

A few other anatomical and clinical contributions to the knowledge of horseshoe kidney were published by Robinson, Newman, Pallazzoli, Papin and Iglesias, Braasch, Rumpel, Löffler, Eisendrath, Zondek and Eggers. Lipshutz and Hoffman, who have tabulated hospital records of various institutions from here and abroad in a total statistical study of 70,502 bodies examined at post mortem, in which 105 horseshoe kidneys were found, estimated a ratio of 1 case in every 671 examined. Legueu and Papin give also approximately the same rate of 1 case in every 500 or 600 individuals. But since the introduction of urography as a routine method of diagnosis, the frequency with which this type of anomaly is discovered in vivo has considerably increased, and horseshoe kidney is quite

commonly found in any active urological service at the present time. Hence the ratio may now be put at about 1 in 100 or 200 pyelograms. Finally, a review of the literature of recent days shows a considerable number of cases reported and operations that have been performed upon the horseshoe kidney. It also demonstrates the exceedingly great clinical and pathologic-anatomic importance of this semicircular mass of renal substance, its enormous frequency and the associated pathology that is commonly attached to it. Such a study reveals also the surgical and clinical aspect of the proper delineation and accurate diagnosis of horseshoe kidney, particularly since the establishment of this enlightened urographic era which has certainly made such diagnosis possible, as has been well brought out in the contributions of Judd, Braasch and Scholl, Rathbun, Eisendrath, Phifer and Culver, Kidd, Colston and Scott, Higgins, Papin, Kretschmer, Young and others.

IV. EMBRYOLOGY

The development of the urogenital system in the human embryo is an exceedingly interesting subject that brings out the complex reasons for the multiple different types of congenital anomalies of the upper urinary tract. Hence, in dealing with a congenital malformation *per se* it is proper to study briefly the genesis of the fused kidney, in an effort to point out the possibility of its early occurrence.

In the embryological evolution of the kidney we are dealing with the development of three essential organs that are formed successively and owe their derivation to both the mesoderm and the entoderm; the last of these three to develop is the one that will serve ultimately to establish the permanent kidney. These three organs are the pronephros, mesonephros and metanephros, respectively. The way in which they develop to form the excretory urinary apparatus has been described and discussed by many authors. It is amazing, however, to observe the rapid evolution of these three distinct organs during the early days of embryonic life when the two renal buds are placed behind the Wolffian duct even before the cloaca is divided to form the rectal and urogenital sinus, and when the kidney anlagen undergo a number of changes, both as to form and position, which undoubtedly are the true underlying factors

in the development of this congenital malformation. Although it appears that the stage of development at which the fusion of the two organs may take place has not been definitely determined, it is

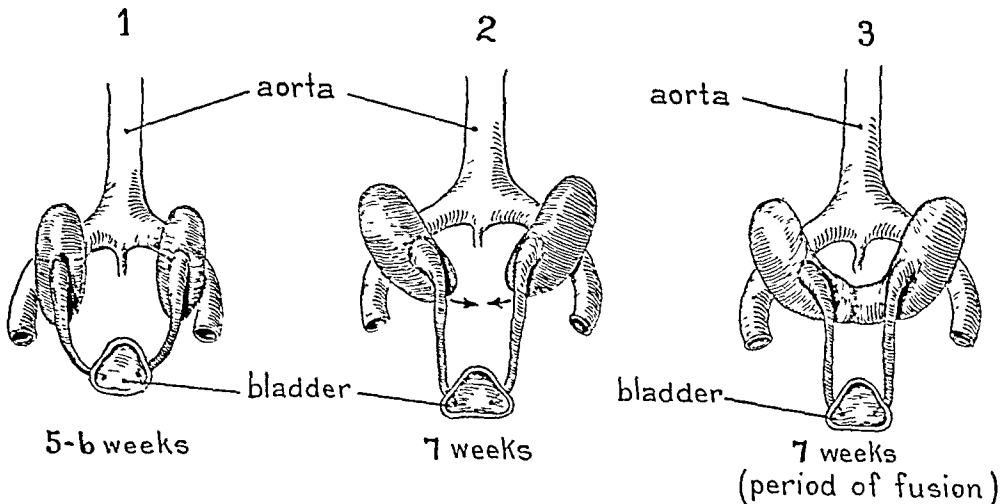


FIG. 6. Diagrammatic drawing showing the different stages of ascent, rotation and migration of the kidneys during embryonic life and revealing the theoretical occurrence of fusion to form the horseshoe kidney.

1. Shows the anterior position of the renal pelvis during the first weeks of fetal life, when the organ is located low down in the pelvis in front of the aorta and behind the future bladder.

2. Represents the two kidneys in their ascent, rotated inward toward the midline, with the two lower poles of the kidney blastemata meeting each other topographically in front of the aorta at the level of its bifurcation into the two iliacs, which may result in a mechanical interference of the normal migration and ascent of the two organs.

3. Illustrates the formation of the actual renal fusion to make the horseshoe kidney during the seventh week of intrauterine life. It appears that this fusion occurs for lack of migration and rotation before the two kidneys ascend from the bony pelvis to their normal position in the lumbar fossae of the adult. The drawing therefore illustrates the possibility of its common occurrence during the early days of embryonic life. Note how the two aberrant pelves remain in front of the renal isthmus. (Modified drawing from Kelly and Burnam.)

nevertheless assumed that the union of the kidney blastema of the right side with that of the left occurs very early in intrauterine life, mainly in view of its topographical relationship and the striking fact that the kidney during its growth migrates and undergoes a rotation around its longitudinal axis. In the course of the evolution of its migration the kidney travels upward or craniad from its original position at the level of the second sacral vertebra to the lumbar region of the adult. The most logical time, therefore, for the fusion of the two organs would appear to be between the fifth and seventh weeks of embryonic life, when the terminal sprouts have

become imbedded in the specialized renal blastema and the two organs are placed closely side by side in the indifferent pre-aortic mesodermal tissue, on the mesial aspect of the caudal poles of the mesonephros (see Fig. 6). Furthermore, it is also possible, as some writers have pointed out, that, as a result of the close relation of the kidneys to the umbilical arteries and to the bifurcation of the aorta into the two iliacs, and the fact that the kidneys are lodged low in the pelvis, the arteries may react as some sort of mechanical obstruction interfering with the upward migration and inward rotation. This would then tend to bring the right and left kidney blastemata together, so that fusion for lack of rotation and ascent may readily take place before the primitive pelvic organ changes its position to become an abdominal organ. If fusion of the upper pole (which is the more rare) occurs, it usually arises earlier than fusion of the lower. At any rate, horseshoe kidneys are generally found to be ectopic, situated low in position about the level of the aortic bifurcation. The renal pelves are always in front, anterior to the blood vessels, and the ureters pass over the ventral surface of the isthmus of the fused organ, revealing the enormous aberration of the anatomical structure from the original position in which it is observed during the early days of fetal life.

Examples of this early renal fusion have been recorded in the literature by Felix, who observed a fused kidney in an embryo 30 mm. in length, or about fifty-five days old, in which the isthmus was caught by the inferior mesenteric artery. Schaeffer also has observed a fusion of the two kidney blastemata in an embryo approximately one hundred days old. Obviously, therefore, the genesis of the fused kidney is best explained on an embryological basis. Hence, one may reasonably conclude that fusion of the two kidney blastemata, to form the two halves of the horseshoe kidney in the adult, in reality occurs much more easily, and its incidence is therefore considerably greater, than the frequency of its clinical discovery has ever led us to suspect.

V. ANATOMIC STRUCTURE

In studying the anatomic structure of the horseshoe kidney, it is necessary on account of its clinical and surgical importance to divide the work as follows:

- i. General description of the organ
- ii. Excretory apparatus, comprising calices, renal pelves and ureters
- iii. Blood, nerve and lymphatic supply
- iv. Topographic relation to the organs situated in front of and behind the semicircular renal substance.

i. The form of the symmetric horseshoe kidney is that of a typical horseshoe or semilunar mass of renal parenchyma. When the fusion is made by the union of the two lower poles, with a concavity looking upward, it constitutes a solid bridge of renal substance extending across the midline of the vertebral column. When the fusion is by the upper poles of the two kidneys, the concavity formed looks downwards. As a rule the form adopted is quite irregular, in the general shape of a v or u, with the point of the angle at the middle portion of the union of the two organs. The two halves seldom have the same form or position; sometimes the right one is larger and lower than the left, or vice versa. The external configuration of the anterior surface of this kidney is very striking, since it retains the marked lobulation and furrows of the fetal organs, while the posterior surface is generally smooth with a middle furrow in the isthmus, formed by the passage of and the close relation to the great abdominal vessels. But what appears to be even more constant and striking is the fact that, in addition to their union, the hilum of the organ is almost always ventrally and inwardly placed as is also the excretory apparatus, which has been definitely shown by embryological and cadaveric observation. These horseshoe organs are situated in front of the great abdominal vessels and behind the peritoneum in the retroperitoneal space.

Two types of horseshoe kidney are encountered: the true, in which the isthmus is an actual solid renal parenchyma, and the false, in which the fusion is made through contiguity of the two organs by a fibrous band of tissue and accordingly without union of the true renal substance. Anatomically as well as physiologically the position occupied by this unique organ in the human body is of paramount importance. Horseshoe kidneys are in general anterior, since their isthmus has become an abdominal organ lying unusually low at the umbilical region and at the level of the fourth or fifth lum-

bar vertebra, sometimes even lower in the pelvis, but more commonly at the level of the aortic bifurcation.

In order, therefore, to indicate more graphically the variations of position that are most commonly observed, I have had a drawing made that will illustrate the most important types gathered from a review of the literature and from a study of the 25 personal cases that I am reporting (see Figs. 2 and 3). In the asymmetric type of renal fusion a marked degree of dystopia is the rule and the organ is commonly found lying at the promontory at the concavity of the sacrum or even far down in the pelvis behind the urinary bladder in the midline or at either side of the abdomen. This dystopia of the asymmetric horseshoe organ is so marked that many times it has been confused with a fibroid uterus in the female or a tumor of the sigmoid, easily palpable by rectal touch.

The weight and the size of the horseshoe kidney are variously described by the different investigators and may vary according to the associated pathology present; for example Legueu and Papin give about 300 gm., while Newman mentions 460 gm. and in our own 4 cases found at post mortem the weight has been from 280 to 350 gm., and hence a little more than the combined weight of two normal kidneys in the adult.

The organ as a rule is fixed and deeply incarcerated by its isthmus to the surrounding structures and blood vessels. In reality it is this lack of mobility that is responsible for its clinical syndrome. However, the two lateral halves and the superior poles that swing laterally to the lumbar region and which are sometimes widely open, may be freely movable, making surgical approach to either of the halves of this organ easily possible. The isthmus of the horseshoe kidney, together with the peculiar arrangement of the calices, renal pelves and ureters, constitutes the most characteristic feature of the renal fusion. The different types of isthmus have already been discussed. Anatomically the structure of the isthmus is of interest for its aberrant blood vessels, its gross size and its important relations, as we shall see later. Some authors have mentioned a third kidney formed from the enlarged and thickened isthmus, such as was observed in the cases reported by Rayer, Kuster and other investigators, and in one case of our own. But the phenomenon was in reality the retained fetal lobulation of the ventral

surface, so that the existence of the third kidney has never been demonstrated.

Histologically the isthmus is as a rule made up of solid renal parenchyma with cortical and some times medullary substance, microscopic sections of which reveal convoluted tubules and a number of normal or atrophic glomeruli.

According to Robinson, Beyer, Newman, Carlier and Gerard, Papin, Eisendrath and other writers, the isthmus joins the lower poles in about 90 to 95 per cent of cases and the upper poles in only about 5 to 10 per cent.

In our series there is only one case of this very rare variety, which was found at necropsy. It is illustrated in the drawing of Figure 5, where the fusion of the two kidneys occurs at the upper pole or more nearly at the upper middle portion of the two organs, forming an irregular letter H, with the isthmus lying across the vertebral column in front of the great vessels, and composed of solid renal parenchyma.

11. The excretory apparatus of the horseshoe kidney comprises the calices, the pelves and the ureters. These by their peculiar arrangement play the most important rôle as the typical anatomical structure, revealing the congenital malformation clinically and urographically. They are also the chief clinical and surgical factor in the causation of pathological conditions, ultimately giving rise to symptoms which reveal complicating infections and diseases due to lack of drainage.

Most writers and observers agree that the calices and pelves are as a rule markedly irregular in size, shape and position, owing mainly to the incomplete rotation of the organ as we have already seen in our embryological study. The pelves are generally two, situated ventrally or anterior to the blood vessels. They enter the horseshoe mass by the hilum independently of each other and hence constitute two separate organs. They are intrarenal or extrarenal and the variations in form, size and position are so great and so bizarre that one may say there are not two pelves alike even in the same case. The multiplicity of calices is the rule, and particularly striking is their reverse position looking inward toward the spinal column. The peculiar arrangement is most constant and characteristic in the lower calices, in view of their extension into the renal

isthmus and their consequent crossing in front of the vertebral column, as seen in the urographic studies. There are generally two ureters, one on each side of the vertebral column, passing across and in front of the renal isthmus to reach the pelvis in a peculiar angle. Because of their high implantation, it has been clearly recognized that there is a mechanical obstruction of some sort at the uretero-pelvic junction, always resulting in the compression of the abdominal content by the overlying structure and in the production of retention, hydronephrosis, pyelonephrosis and other diseases in these kidneys.

Anomalies in the excretory apparatus of the horseshoe kidney are of quite common occurrence, the incidence of which is revealed by a brief survey of the literature. It is obvious that when the renal mass is ectopic in the bony pelvis, displacement and shortening of the ureters are a common observation. Cases of 1, 2, 3 and 4 ureters have been reported and observations of 1 to 4 pelves are also on record.

Anomalies in the location of the pelves are frequent. Kuster reported a case in which the right pelvis was found in the middle portion of the isthmus bridge with the ureter running almost perpendicularly between the aorta and vena cava.

Landouzy, Robinson and Durham have reported cases in which the ureters passed behind the isthmus. Carlier, Thacher and others noted a single ureter arising directly from the isthmus.

Losée reported the finding of a case with two left ureters which entered the bladder separately. Massari in 1897 reported a case with an ectopic ureter opening in the vulva. Robinson in the study of 55 specimens collected from the literature and from autopsy findings described a case of bilateral reduplication of ureters and pelves, showing 4 ureters and 4 pelves all entirely independent and opening normally into the bladder.

In our own series there is one case diagnosed cystoscopically and pyelographically in which 3 ureters opened into the bladder and 4 renal pelves could be seen in the pyelogram (see Figs. 26, 27 and 28). There is also a report of another case, which was found at post mortem, having 3 ureters opening into the normal bladder, as shown in the drawing of Figure 4. Later on, in the section on diagnosis, I shall discuss the rare occurrence of normally situated pelves in

the pyelographic studies of horseshoe kidney, and also the rotation of the calices and pelves without the presence of horseshoe kidney.

The presence of concomitant anomalies of other organs must also be emphasized, since many such cases are reported in the literature and appear to have some constant clinical bearing. Although the suprarenal glands are embryologically, functionally and anatomically in intimate relation with the kidneys, these organs according to various writers and post-mortem investigations always preserve their independent function and their normal anatomical position on either side of the spinal column even in cases of marked dystopia. Fusion of the two suprarenal glands may, however, occur, and cases of this type are on record. Thus Neusser has described a case in which a union of the two suprarenals occurred in the form of a horseshoe suprarenal. Kelly too describes a case of fusion of the two kidneys by the upper pole in an embryo with spina bifida, diaphragmatic hernia and fusion of the adrenal bodies. Many other anomalies of interest are frequently associated with fused kidneys, among which malformations of the genital organs appear to be more frequently observed than any other variation, owing mainly to the close connection between the müllerian and urinary ducts during the developmental stage.

Goddard for example reports a case of atresia of the rectum and patency of the urachus, and Ballowitz in 103 cases of renal malformations found 73 concomitant abnormalities of the genital organs. Quite common too are anomalies in the blood vessels supplying the horseshoe organs, as has been pointed out by Papin, Eisendrath and others; in fact aberrant vessels may be formed from any contiguous structure where the kidneys are lodged.

III. The blood, nerve and lymphatic supply of the horseshoe kidney merits a careful study on account of the anatomical, surgical and clinical significance that it presents, as follows: (a) The blood vessels, in addition to the physiological function of the circulation, contribute greatly to the maintenance of the position of the horseshoe organ, and therefore play an important rôle in the risk and difficulties to be encountered in any operative approach. (b) The nerve supply is responsible for the nervous irritability in the early symptoms and clinical manifestations that have been observed. (c) The lymphatics have perhaps been the principal etiological

route of infection and early pathological lesions of these anomalous renal masses.

(a) The blood vessels vary in position, size and number and are as a rule anomalous because, owing to their unique position, there are no two organs alike with the same arterial or venous supply and also because of the presence of anastomoses and collateral branches, as well as of superficial plexuses which have received extensive attention from many authors.

The blood vessels in most instances connect directly with the aorta and vena cava. As a rule there are from 4 to 6 renal arteries, extending laterally and caudally, two to each hilum to irrigate the corresponding half of the organ, and one or two to the middle portion of the isthmus (see Fig. 1). The two hilar arteries running from the aorta outwardly to the renal mass are sometimes subdivided into two or three branches of the pyelic and retropyelic arteries. The isthmic arteries also may be subdivided into two small branches, superior and inferior, coming sometimes directly from the aorta, sometimes from the common iliac, and sometimes appearing as collaterals from the mesenteric artery. However, in horseshoe kidney the anomalies in blood vessels are so numerous that they may be regarded as the rule.

Papin, studying from the literature 223 autopsy cases of horseshoe kidney, found and tabulated the following renal arteries: 1 artery in 1 case; 2 arteries in 26 cases; 3 arteries in 40 cases; 4 arteries in 25 cases; 5 arteries in 20 cases; 6 arteries in 9 cases; 7 arteries in 3 cases; 8 arteries in 2 cases; 10 arteries in 2 cases; and in 10 cases the authors stated a multiplicity of arteries, without mentioning the exact number. Papin finally stated that, in 189 cases studied, 86 had from 3 to 5 arteries, which is approximately two-thirds of the total cases.

In some cases, when the renal mass is low in the pelvis, some of the arterial branches run from the contiguous trunk, as the iliacs, the middle sacral and the hypogastric, and in rare cases anastomosis may be found from the spermatics, the mesenterics and the colics.

The important and close relation of the renal isthmus to the great abdominal vessels has already been mentioned. As a rule the bridge of the renal fusion is situated anteriorly, so that the posterior surface of the isthmus is marked with a furrow for the passage of the great

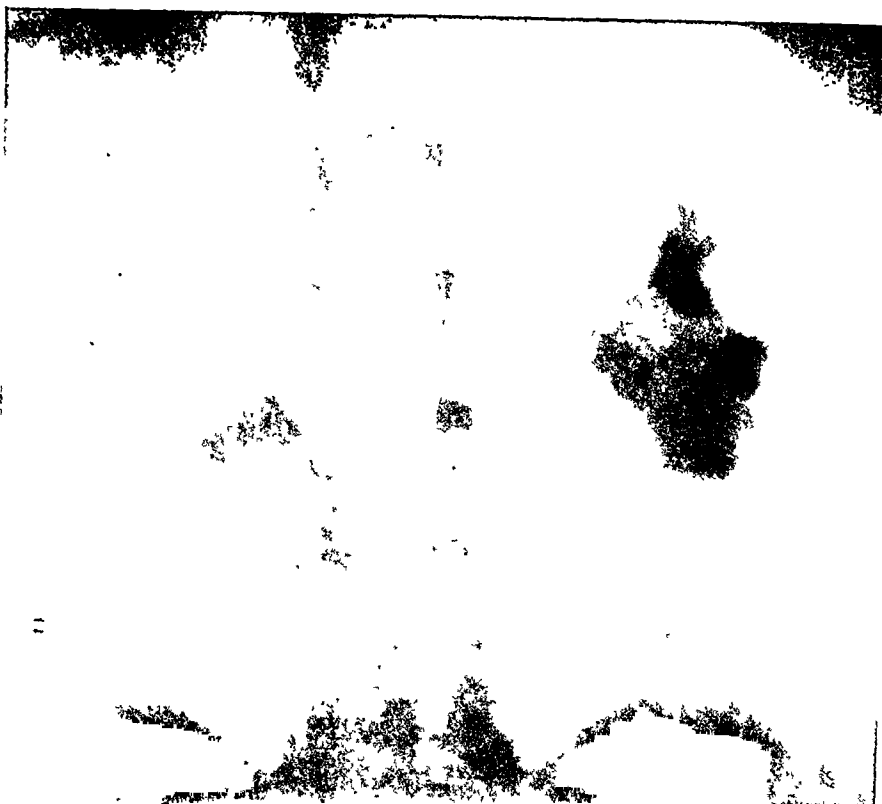


FIG. 7. Plain roentgenogram of Case IV, representing two enormous shadows of a coraliform calculus occupying practically the entire right and left pelves of a horseshoe kidney. Notice on the right the shadow of the calculi placed obliquely and overlapping the body of the third and fourth lumbar vertebrae. On the left side the lower calices are filled with the calcified deposits of the stone which also point inward to the midline, so that the plain roentgenogram makes the diagnosis of horseshoe kidney complicating the presence of bilateral nephrolithiasis. (Hernandez's Case.)

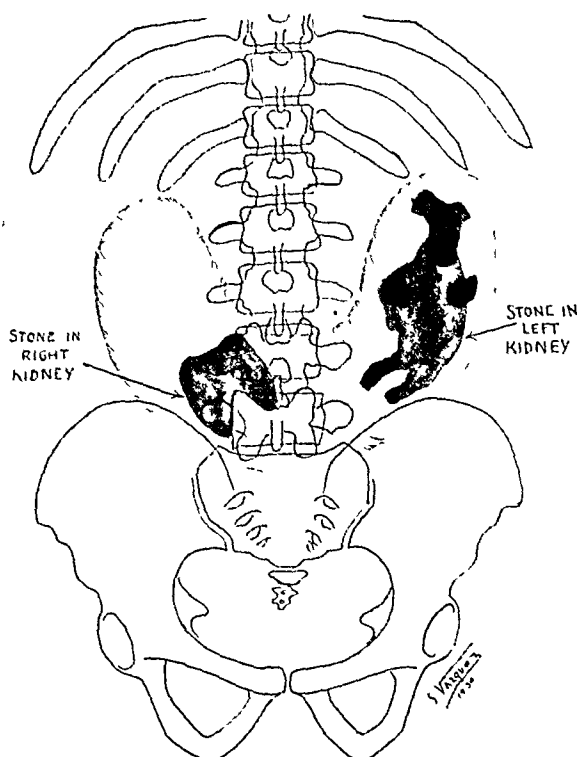


FIG. 8. Drawing of same case made from Figure 7, revealing the position of the horseshoe kidney in close relation to the vertebral column and bony pelvis, with the two enormous coraliform stones that were later confirmed by pyelographic examination.



FIG. 9. Bilateral pyeloureterogram of Case 1, revealing the inward rotation of right and left pelvis and their close proximity to the vertebral column; also showing the peculiar position of the lower calices extending into the isthmus and revealing the presence of horseshoe kidney. This patient has been suffering from chronic constipation from birth and was acutely ill when he came into hospital with various erroneous diagnoses. Complete urological examination disclosed the presence of horseshoe kidney disease, which was treated successfully by the method of the indwelling ureteral catheter as shown in Figure 41.

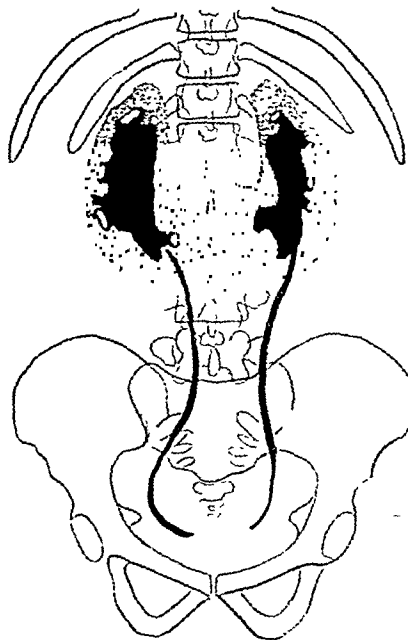


FIG. 10 is a drawing of Case 1, revealing the position of the horseshoe kidney and the peculiar arrangement of the inward rotated pelvis and of the lower calices extending across the renal isthmus, which made possible a definite diagnosis of horseshoe kidney disease. Note that the ureters appear to come from behind. Clinically the horseshoe kidney syndrome has been markedly present for more than fifteen years.

vessels. However, instances have been observed in which the aorta and vena cava are anteriorly located, crossing the isthmus ventrally.

Nixon has reported a case in which the isthmus of the renal fusion passed behind the great vessels and Kelly described a case of fusion of the upper poles with fusion of the adrenals, all passing behind the great vessels and between them and the vertebral column. Carlier has emphasized the fact that in fusion of the superior poles this rare deviation from the posterior position of the great vessels is very conspicuous. Robinson in reporting a case stated that it occurs in 10 per cent of the cases, but it is obvious that this percentage is rather high when only 3 or 4 cases of this type are mentioned or described in the survey of the literature.

(b) The nerve supply of the horseshoe kidney is anatomically, physiologically and clinically of great significance, and only by studying its intricate topographical relationship can we come to explain the peculiarities of its clinical syndrome, which is not yet well understood.

We know since Cruveilhier gave its description that the nerve supply to the normal kidneys originates from the solar plexus and the branches of the splanchnic nerve; also that a network of anastomoses of the sympathetic and parasympathetic nerves is formed in the constitution of the renoaortic ganglions and renal plexus, which by terminal prolongation following the course of the renal artery reaches the hilum and penetrates into the small capillaries of the organ. But it is the retroperitoneal space, between the peritoneum and the vertebral column where the horseshoe kidney is lodged, that offers the most striking picture of the topographic and close relationships of the abundant nerve roots, too striking indeed to be overlooked in the causation of epigastric pain and the horseshoe kidney syndrome in its early clinical manifestation.

In fact the solar plexus originates from branches of the right and left semilunar ganglions, which are formed by branches of the splanchnic and phrenic nerves, and also by numerous plexiform branches directed transversely from one semilunar ganglion to the other, and making further anastomoses with the right pneumogastric or vagus nerve. Still further interanastomoses and plexiform branches are formed in front of the aorta, giving exit to the renoaortic ganglions and celiac plexus, the intermesenteric plexus,

FIG. 11. This drawing represents the anatomic structure and topographic relation of the organs situated in front of and behind the isthmus of the horseshoe kidney, and serves to point out the important relation to the blood, nerve and lymphatic supply and the etiological rôle played by these in horseshoe kidney disease. Notice that, in a section made in a horseshoe organ where a great portion of the isthmus could be removed, the organs situated behind it are bound together and incarcerated by the pressure and tension which the isthmus of the horseshoe organ constantly exerts by its weight, its lack of mobility and the intra-abdominal pressure it exerts, which are responsible for the characteristic horseshoe kidney syndrome that has been observed clinically in practically every case of this series. (Modified drawing from Testut and Jacob's Anatomy and Papin's Chirurgie du Rein.)

- A. Phrenic nerve.
- B. Splanchnic nerve.
- C. Semilunar ganglions.
- D. Reno-aortic ganglions.
- E. Pecquet's cisterna.
- F. Sympathetic nerve.
- G. Vena cava.
- H. Aortic lumbar plexus.
- I. Pneumogastric nerve.
- K. Splanchnic nerve.
- L. Semilunar ganglions.
- M. Reno-aortic ganglions.
- N. Renal plexus.
- O. Thoracic duct.
- P. Sympathetic nerve
- Q. Aortic artery.

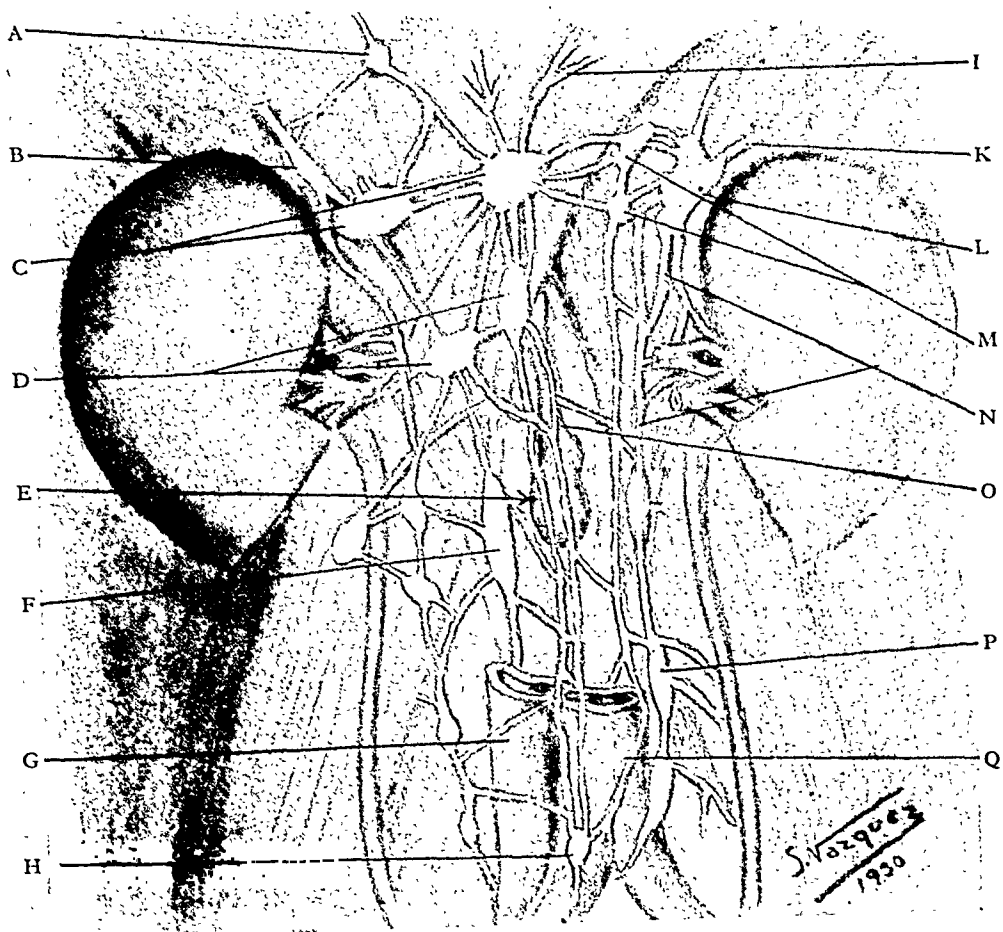


FIG. 11.

and finally the richly organized and sensitive solar plexus, which is of paramount physiopathological importance not only because it sends branches to almost all the viscera of the abdomen but also because of its exquisite sensitiveness and response to sensations, pressure and irritations, expressed in sudden pain and gastro-intestinal disorders, producing so-called epigastric or umbilical pain. Hence it is logical to assert that beyond a doubt the continuous pressure exerted by the weight of the isthmus in cases of horseshoe kidney upon these anatomo-physiologically important structures of blood vessels, nerves and lymphatics, will account to a great extent for the persistency of the chronic suffering and the clinical syndrome of this potential clinical entity. The relations of these structures are brought out graphically in Fig. 11, a modified drawing after Testut and Jacob, Papin and others.

(c) The lymphatic circulation is also of considerable importance in the pathogenesis and clinical development of horseshoe kidney disease. First of all we have the multiplicity of lymphatic ganglions which essentially constitute the lymphatic system of vessels, situated in the cellular retroperitoneal space, at the renal pedicle and running parallel on both sides to the great abdominal vessels, where they lie in the form of a chain, connecting the lymphatic circulation of the iliac group of ganglions with that of the lumbo-aortic. In addition to these we must not forget that behind the aorta and vena cava and between the vertebral column and the great vessels, lies the mother lymphatic reservoir of the chyle, Pecquet's cistern, which may also be cut off, and therefore affected physiopathologically, by the extra pressure of the isthmus of the horseshoe renal mass in front of it, interfering with the normal circulation of the lymphatic ducts and the chain of lymph-nodes (see Fig. 11). Horseshoe kidney would thus play an important etiological rôle in the stagnation of lymph, producing infection, symptoms and diseases of the organs of the retroperitoneal space where the horseshoe kidney holds a prominent place. An example of this pathogenetic condition is readily seen in the third-case of the 4 autopsy cases I am herewith reporting. (See Case xxiv)

Briefly, the case is that of a young man thirty-five years of age who was admitted to the medical wards of the New York Hospital complaining of abdominal pain with slight frequency of micturition and who, after a month of observation, was submitted

to an exploratory laparotomy for an undetermined abdominal tumor, which proved to be a retroperitoneal lymphosarcoma. Three weeks later at post mortem a horseshoe kidney was disclosed with an enormous lymphosarcomatous mass lying at the thoracic duct or Pecquet's cistern, densely adherent and covered by the isthmus of the fused horseshoe renal mass, with many metastases and marked emaciation that proved to be the direct cause of his death.

iv. The topographic relations of the horseshoe kidney have not been well studied and are certainly of capital importance. The relations vary mainly according to the position in which the organ may be found and the type of horseshoe kidney encountered, and have great significance for the pathogenesis of early clinical manifestations and for the surgical management of this condition.

The most important anatomic structures and topographic relationships of the congenital anomalous organ have already been discussed in Sections I, II and III; so I shall at this time merely point out the rôle of the close relationship to the peritoneum and its abdominal contents.

Although, like normal kidneys that are normally placed in the lumbar region, the horseshoe kidney is well protected by the enveloping prerenal and retrorenal fascia of Zuckerhandl, and although it is still well surrounded by the dense fatty capsule, which preserves it from injuries and facilitates the physiological movements during inspiration and expiration, the isthmus in this anomalous kidney lying in front of the great vessels in the cellular retroperitoneal space, lacks the presence of the renal fatty capsule, so that its mobility is reduced to a minimum and the kidney becomes virtually a true and permanent fixed organ resting in the middle of the abdomen, incarcerated by the surrounding structures and pressing directly upon the circulation of the great vessels, upon the solar plexus and its many vasovisceral branches and also upon the lymphatic circulation of all the organs of the abdominal cavity and of the lower extremities.

The parietal peritoneum with its posterior layer exquisitely supplied with lymphatics and nerves lies directly upon the fused bridge of renal parenchyma and is only separated by a thin layer of the prerenal fascia, which crosses the midline to continue with that of the opposite side, but without the perirenal fatty capsule. The peritoneum is therefore densely adherent to the anterior surface of the renal mass as well as to its excretory apparatus, the pelves

and the ureters, which are also ventrally situated. Undoubtedly under these conditions the intra-abdominal pressure and the weight and close relation of the intra-abdominal organs which are bound together upon it—such as the duodenum, the head of the pancreas, part of the stomach and liver and sometimes the transverse colon, or even, when the organ is low in the pelvis, the sigmoid, small intestine, epiploon and other intra-abdominal organs closely related to it—must play an evident rôle in the urinary stagnation and early clinical manifestations, as has been definitely observed in this series of cases.

The reflex response of the solar plexus to the continuous insult would then produce intestinal motility and increase of peristaltic waves with irregularities in the dynamic contraction of the ureters and pelves, bringing on a marked stagnation characterized clinically by a history of intestinal disorders with chronic constipation and intermittent attacks of pyelitis and pyelonephritis, as we shall see later in the description of many of the cases here reported.

VI. ETIOLOGICAL FACTORS

In considering the etiological factors of horseshoe kidney disease, the type of renal symphysis that we shall discuss is the one most commonly observed clinically, namely the symmetric type of renal fusion by the lower poles with the concavity facing upward and the isthmus lying across the midline of the abdomen in front of the great vessels. In this disease the incidence of age and sex has not played any important part, although in our series of 25 cases, herewith reported, 17 of the patients were males over eighteen years of age and 8 were females ranging in age from twenty to forty years, with an average of thirty years and a greater percentage of the male.

The horseshoe kidney may be found at any age, but as a rule it is not discovered clinically until a superimposed infection sets in, since the signs and symptoms are overlooked in childhood and the diagnosis in this condition is seldom made. The principal factor in the disease, even in normal horseshoe kidney, is the chronic irritability of the organ itself as well as of the structures in its vicinity, particularly the parietal layer of the peritoneum because of its vascular supply. The continuous irritation of this serosa and other neighboring tissues and structures during the normal

movements of the body tends to produce a certain degree of potential irritability which naturally results in tissue inflammation and stagnation of both the urinary and the gastrointestinal tract.

The unique position of the isthmus lying across the midline is mainly responsible for this irritability because of the pressure which its weight exerts upon the abdominal organs, both those retroperitoneally and those intraperitoneally situated. These organs are so bound together and are so closely adherent that the increased abdominal pressure to which they are subjected is sure sooner or later to cause rectal and vesical symptoms which, combined with the characteristic epigastric or umbilical pain, constitute the true horseshoe kidney syndrome.

Furthermore as a result of the abnormal anatomic position of the pelves and ureters, which are situated ventrally and pass across the isthmus of the anomalous kidney, the rhythmic dynamic contractions and physiological movements of these organs are sooner or later interfered with, causing the development of pyelitis and peripyelitis, of ureteritis and periureteritis. These conditions gradually extend to both ends of the ureters, to become, after a chronic process of long standing as in chronic nephritis, an acute or exacerbated one, characterized by pyelonephritis with some urinary stasis, back pressure and consequent cystitis, for which the patient is finally examined. A pyclographic study will then reveal the presence of horseshoe kidney disease in its essential purity, before the presence of a gross concomitant pathology can be established.

As the early symptoms progress the clinical picture may become aggravated, with the general system also becoming involved, essentially through lack of drainage, and through intense pyelonephritis, followed by recurrent attacks of fever, chills, general sepsis, ileus and uremia. In our series, half of the patients have been more than once critically ill, and one of them, a medical student, died with the clinical description given here. These facts, like those in polycystic kidney disease, reveal that the occurrence of renal failure is bound to be more common than is generally expected.

At the same time other clinical manifestations may arise as the result of this condition. The isthmus of the horseshoe organ is deeply fixed and practically immobile, resting in its prominent position across the vertebral column, and the direct pressure it exerts

upon the great abdominal vessels, more pronounced for lack of a fatty capsule at the renal bridge, offers anatomically conclusive evidence of the etiological rôle played by the faulty circulation of the extremities and abdominal viscera, which may be a concomitant factor in the development of the associated pathology. The lymphatic and the nerve supply may also be interfered with as a result of the traumatic body insult, the lymphatic interruption resulting in stagnation of the lymph in its mother reservoir, the cistern of Pecquet, while the nerve interference causes over-stimulation of the most exquisitely sensitive area of the solar plexus and its visceral branches. Furthermore, as the isthmus rests upon the aorta, the continuous rhythmic contraction of this great artery in systole and diastole affects the organ and tends to produce symptoms of aortitis and even aneurysm, as has been reported in several instances in the literature and as was observed in one of the 4 autopsy cases in this clinical study. Accordingly it is common to observe compensating cardiac hypertrophy, thrombosis of the iliac veins and phlebitis of both legs for lack of circulation as the result of the horseshoe kidney disease.

All these etiological factors and their vivid clinical pathology convince me of the fact that we are dealing here with a true clinical and anatomo-pathological entity which must be recognized as the horseshoe kidney disease.

(To be continued)

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EDITORIALS

LEST WE FORGET

FOR the past two decades two men have been prominent in American obstetrics. They were the generals leading the forces of conservatism in midwifery. In their writings, daily contact with students and practice, both John Osborn Polak and J. Whitridge Williams were the generals of the forces of sanity in this branch of medicine.

While in this country the published mortality records are nothing to point to with pride, these gentlemen, in their efforts to make childbearing less dangerous, continued to preach and drive home the fundamental lessons of giving nature a chance, eschewing the bizarre and radical. They believed that more hours should be

devoted to the teaching of obstetrics in the undergraduate schools. They affirmed that students should have an opportunity for a wide acquaintance with the clinical side of obstetrics in the delivery-room and prenatal clinic. They were insistent that all teaching should emphasize time-tried, conservative measures. When obstetricians of more or less reputation advocated short cuts to delivery, for the most part entailing meddlesome midwifery, Polak and Williams claimed the methods were to be condemned because it gave the neophyte a set of false values which would result in human havoc later in their professional careers.

It has been common knowledge that there are some in this country who have

sought publicity by suggesting all sorts of fantastic procedures, procedures aimed to shorten labor and effect rapid birth. But these men have never come into the open and dared the fight. Whenever they lifted their heads above the scientific hedge Polak and Williams were not slow to hit and in scathing terms condemn and so prevent the questionable ideas from gaining a foothold and becoming popular with the common run of practitioners, who get their ideas from the higher-ups.

We sit back and wonder if these men of radical tendencies will now bravely run into the open and deluge the profession with a thousand and one new ways of terminating normal labor. It would not surprise some if in their zest to get the spotlight will go to the great length of advocating cesarean section in all cases. Those who believe in conservative obstetrics must take up the cudgels so ably handled by Polak and Williams and continue the fight for sane methods.

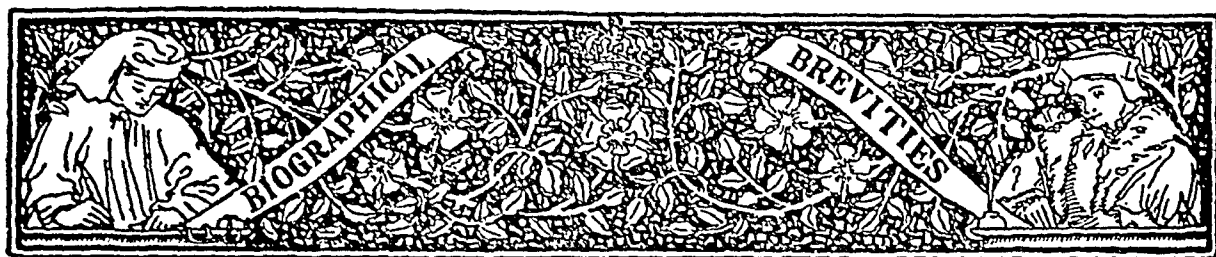
T. S. W.





AUGUSTE NÉLATON

[1807-1873]



NÉLATON'S LINE

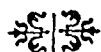
Auguste Nélaton was born in 1807 in Paris. He presided with Malgaigne, who has been described as the greatest surgical historian and critic the world has yet seen, at the Hôpital St. Louis. He comes down in history as an operator and teacher with a reputation as great as that of Dupuytren. We are told that he was a most modest man, quiet in his habits, of a friendly disposition and most considerate of the unfortunate.

He was the first to devise a bullet-probe (this was used in Garibaldi's case). The present-day flexible rubber catheter was his invention. In gynecology, he was the first to describe pelvic hematocele (1851-52), and due to his efforts, ovariectomy was

established in France. His principal work is his "*Éléments de Pathologie Chirurgicale*" (1844-59). The surgeon is familiar with the Nélaton dislocation, the wedging of the astragalus between the widely separated tibia and fibula, usually complicated with fracture. The fibrous tumor or sarcoma lying between the peritoneum and the muscles of the abdominal wall is known as Nélaton's tumor. Nélaton's line is a line drawn from the anterior superior spine of the ilium to the tuberosity of the ischium; normally the great trochanter lies in this line, but in cases of iliac dislocation of the hip or fracture of the neck of the femur, the trochanter is felt above the line.

Auguste Nélaton died in 1873.

T. S. W.





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

BOOKSHELF BROWSING

A CHAT WITH AESCULAPIUS

W. B. HOWELL, M.D.

MONTREAL, CANADA

OF THE thousands of medical men who visited the Carver clinic at Malad City, Utah, during the lifetime of the founder, Dr. Jimmy Carver, there can have been few who did not come away with the impression that the great surgeon was absorbed in his professional work to the exclusion of all other subjects. He had, nevertheless, a hobby in which he was profoundly interested. This was the study of the language, history and literature of ancient Greece. Great though the demands upon his time were during the last twenty years of his life, he made it a rule to devote at least an hour every day to this diversion. His annual holiday, which he took in the spring and lasted three months, was almost invariably spent in a trip to Greece. There were not many parts of that country that he had not visited at some time, on foot, on horseback, or in a motor car.

During one of these trips he found his way to a small village on the shore of the Gulf of Salonika, and started off alone to walk up the slope of Mount Olympus. It was a fine spring morning. The sun, however, was already giving promise of the coming heat of the Greek summer. The path wound steadily upwards through

woods and shrubs and across open spaces where the ground was carpeted with brilliantly colored flowers. Now and then he stopped to look down upon the "wine dark sea," or to feast his eyes upon the majestic beauty of snow-covered Olympus. There were ecstatic moments when the beauty of the scenery made him feel that he was indeed approaching the home of the gods.

After walking for two or three hours, and meeting no one, he came suddenly upon a small temple, partly in ruins and shaded by a few plane trees. There was, over the doorway, an inscription almost effaced by the hand of time. Carver stood for a while trying to read it, but the only word he could decipher was "Aesculapius." He entered the little building and finding its shade very agreeable after the heat and glare of the midday sun, sat down upon a stone bench which was built along the wall on one side of the entrance. Tired with walking he leaned his head against a stone pillar and momentarily closed his eyes. When he opened them he found to his astonishment that he was not alone. Sitting opposite on a bench similar to the one upon which he himself was seated, was an old man with a shining bald head, and

long beard. He was clothed in a garment of snowy whiteness, draped about him in a manner which reminded Carver of an ancient Greek statute. There was a certain grace about its flowing robes in spite of the fact that the body underneath was obviously short as well as corpulent. Beside him, propped against the bench on which he was sitting, was a curiously carved staff. In halting modern Greek, Carver said that he hoped his presence was not an intrusion. His astonishment was great when the old man answered in English, "Sir, I could never look upon the presence of a member of your profession as an intrusion."

"Well, that's very kind of you," said Carver, "but how do you know what my profession is?"

"It would be a strange thing," answered the little man, "if I could not recognize a doctor when I saw him."

"Oh," said Carver, somewhat puzzled, "you are probably one yourself."

"I was—alas I am not now."

"You have retired, I suppose. Well, we all come to it if we live long enough. I shall be giving up myself in a few years. Where did you practise, doctor?"

"I practised my art in many cities and in many countries; in Greece, Asia and Egypt—even in India."

"Well," said Carver, "I've stayed put in one place. Its kind of hard to make a new start."

"I moved from place to place, not because I wanted to, but because I was forced to. My fellow physicians were always jealous of me, and spread reports that I belonged to the hated class of goetes.¹ They roused the mob to set on me and kill me, and often I had to flee for my life. It was my power to raise the dead to life that made my rivals angry."

¹ A class of wizards in ancient Greece who were feared and hated. "They were the confectioners of philtres and poisons; they peddled their craft for money; they raised jars, jealousies, strifes, like a thick scurf o'er life." (Montague Summers: *Geography of Witchcraft*. Lond., Kegan Paul, 1927.)

"Poor fellow," thought Carver, "I wonder if he has general paralysis or paranoia." Then he said aloud, thinking to humor his new acquaintance, "Yes, they wouldn't like you raising the dead—especially those who had been their patients. There might be a demand for explanations. But tell me, how did you restore the dead to life?"

"Ah, many have asked me that question. It is one of the secrets which I have no right to impart. Some of us knew how to do things which you cannot do now, for all your boasted progress. But in the end my secret was my undoing. It has always been believed that Pluto thought that I was defrauding him of his rights, and instigated Jove to strike me dead with a thunder-bolt. It wasn't that at all. It was the heirs of the people I brought to life who thought that I was defrauding them. And they didn't go to Jove about it either. They acted for themselves; that's how I came up here. Besides, the dead themselves were none too pleased about being restored to life. They complained that it was no joke to have to die a second time."

"Say, doctor," asked Carver, with a feeling of growing interest mixed with amusement at his companion's fancies, "would you mind telling me who you are?"

"I am Aesculapius," the old man answered simply.

"Oh yes, Aesculapius; yes, of course, I should have known that," replied Carver tactfully.

"You do not believe me, but my name is Aesculapius as certainly as yours is Carver."

"Tell me how you know my name."

"I have seen you working at Malad City. You see it is one of my pleasures, indeed one of my greatest pleasures, to go about among mortal men from time to time to see how the art of medicine is progressing. It was an art when I practised it. Not so very long ago I thought it was going to be a science, but now I see that it has become a business." He sighed, and then went on, "You have built up a great

clinic. You minister to thousands of sick people—you should be a happy man.”

“Yes, I have made a success of the clinic. But happy—well, I don’t know. I suppose I am as happy as most people. But I don’t seem to remember your face, doctor.”

“That is not to be wondered at,” was the reply, “for when I go about among men I do not appear as you see me now. I seek out some physician or surgeon who is on the point of setting forth upon a round of visits to medical centres or to some convention, and I borrow his body and his name. I lull his spirit to sleep and hide it in the heights of Cytherea or Idalium.¹ I go in his likeness and no one knows.”

“Doesn’t he raise any objections?”

“When I return his spirit to his body I scratch his right ear² and he remembers nothing—not even that he didn’t go. He never admits that he does not remember what happened during his trip. If he did admit it he knows what people would think, and his wife would never let him go away again, not alone at all events.”

“You must have a great love of medical work, doctor,” said Carver.

“I have,” answered Aesculapius. “I am not only the god of medicine but the inventor. It is to me as a first-born child. But it is not only that—you must realize that we immortal gods find the time hangs heavily on our hands. We have so much of it. We can’t always be playing golf or bridge; it takes a fool to do that. Everything we do we remember having done before, not once or twice, but thousands of times. The fact is, immortality is spoiled by memory, and yet without memory we would have no immortality. You mortals don’t realize that your greatest blessing is death, and are silly enough to be afraid

of it.” A look of weariness came into the face of the little old man. He yawned and continued, “It is the infinite variety in disease which makes me long to be a physician again.”

“Isn’t there any opening for a hospital among the gods?” asked Carver.

“Alas no!” said Aesculapius, “I often wish there were. Not that there is no disease among them, but it never gets worse—and nothing can make it any better. Bacchus, now, has cirrhosis of the liver. You know what his habits have been; he has ascites, but it never gets any better or any worse. Once when I first came up here I tapped him. How green I must have been! You wouldn’t believe the fuss the Fates made! They’re the only people among the immortals that grand-papa’s¹ afraid of. They told him. Well, the old gentleman came down here in a desperate hurry to see me about it. I don’t like to think of that time. And then there’s Silenus, the old dipsomaniac. He can’t leave the nectar alone, and never could. I should like to try the effect of pilocarpine on him. No wonder Bacchus got the habit with such a tutor. I used, too, to want to do something for Polyphemus’s eye. Ulysses made a dreadful mess of it. And it wasn’t only his eye; his digestion was permanently impaired. He gorged himself on Ulysses’ friends and drank too much of that miserable Greek wine.² I don’t know whether it was the Greeks or the wine, but he hasn’t been able to keep a Greek on his stomach since. Polyphemus hasn’t had much of a life since those days—blind and dyspeptic. And then there’s Vulcan with his malunited fracture. It would not be easy to reset; the bones of the gods are very hard. Yes, I’ve often thought we could have an excellent hospital. We’d have a nursing school and train nymphs and naiads. They would be much better

¹ “But to prevent suspicion, will I steep
His temples in the dews of balmy sleep,
Then to Cytherea’s sacred seats remove,
Or softly lay him in the Idalian grove.”

(Virgil: *Aeneid*. Bk. i, 11, 680-681;
Christopher Pitt’s translation.)

² “The seat of the memory lies in the lower part of
the ear.” (Pliny: *Natural History*. Bk. xi, chap. 106.)

¹ Aesculapius was the son of Apollo, who was the son
of Jupiter.

² “Ejecting from his monstrous maw
Wine mixed with gore, and gobbets raw.”

(Virgil: *Aeneid*. Bk. iii, 11, 632-3.
Conington’s translation.)

off employed in a hospital than roaming about the woods and streams without a chaperone and getting into trouble with the fauns. We'd do as you do in America; let them think they're college students. We'd give them plenty of lectures and encourage them to wear class pins and blazers and have a college yell. And every little while we'd give them a degree. I'd let them have a dance now and then and ask their faun friends. It is too bad that Argus isn't living. We could have employed him to watch the nurses at the dances—fancy a chaperone with a hundred eyes—and what a hall porter he'd make for night duty!"¹

"You wouldn't need Argus," said Carver, "if you put the training of your nurses into the hands of the Graces. Their influence, I am sure, would—"

"Yes," interrupted Aesculapius, "their influence would be excellent, but the trouble is that they never wear any clothes. I am afraid it wouldn't do at all—such a bad example for the nursing school and so disturbing for the patients. We could get Neptune," he continued, "to take charge of the department of hydrotherapeutics. His sea nymphs could be trained to help him. Aunt Lucina¹ could take charge of the maternity wing, and Ceres would, of course be our dietitian. And think of the advantages of having centaurs trained in first aid for the ambulances!"

"How about Hercules?" asked Carver, "A strong man is invaluable about a hospital sometimes. Didn't Eurysthenes find him very satisfactory as a chore man?"

"Oh, we could find him better employment than doing chores," replied Aesculapius, "I'd give him charge of the department of remedial gymnastics. He'd

be glad of something to do, and then he'd be useful in keeping the house doctors in order. He would like the exercise. He's getting disgracefully fat."

"Your staff would be a highly efficient one, doctor," said Carver, "but it seems to me as if it would be rather out of proportion to the number of patients you seem likely to have. After all, a hospital exists for the patients."

"Not necessarily; you know that even in America patients aren't always the first consideration. Some hospitals exist for the benefit of a university, some for the advancement of science, some for the good of the medical staff, and some to impress visitors. I know hospitals which exist, as far as I can see, for the benefit of the nurses, and one or two apparently, for the orderlies. I daresay," he continued, "grandpapa wouldn't mind very much our having a hospital if we asked him to be president. Of course, we'd have to watch him when he made his visits. We should have to keep the nurses out of sight. There has been at one time or another a good deal of scandal about him. You remember the episode of Io? That sort of thing wouldn't do in a properly conducted hospital—fancy the old gentleman petting one of our nurses and then turning her into a cow when he saw Juno coming!"

"You haven't said anything yet, doctor," said Carver, "about your department of surgery."

"No, of course that would be a great problem. I don't know how we could ever get a surgeon into Heaven. As we wouldn't have any deaths," Aesculapius went on, after a pause, "we wouldn't need much in the way of a pathological department. We could get Pluto to give us some ground in the infernal regions to build a department of research. I used not to like him at one time, but we have made up our quarrel. His place isn't far from here. He'd let us use Cerberus for experimental purposes if we put it up to him tactfully. Think of the advantages of working on a dog with three heads."

¹ This Argus had an hundredth eyes:

of which by turne did sleepe

Always a couple, and the rest did

duely watch and warde

And of the charge they took in hande

had ever good regarde

Ovid: *Metamorphoses*. Golding's Translation.

¹ Lucina was a daughter of Jupiter, and presided over the birth of children.

"Wouldn't he be rather large and fierce to handle?" asked Carver.

"Yes, perhaps. But you could give him a preoperative sedative,¹ and then Morpheus and Somnus could put him to sleep. They'd make excellent anesthetists. It wouldn't do any harm to amputate the third head and it would be easier for the anesthetists. It would cut down his barking by a third. The antivivisectionists would make a fuss, but—"

"Do you mean to tell me," interrupted Carver, "that there are antivivisectionists in Hell?"

"My dear sir, it is crowded with them, and they are just about as reasonable there as they were on earth. If you were to try to do anything for the benefit of science to one of the vultures which have been tearing Tityus' liver for these thousands of years the antivivisectionists would make your life in hell a burden. They don't mind Tityus' feelings, though."

"Tell me, doctor," asked Carver, "what sort of a place is Hell? Is it so very terrible?"

"No, not particularly so," was the reply, "there are a great many delightful and amusing people there. It is a little dark in spots and at times quite sultry. Tartarus is the worst part of it.² That is

where the abortionists go, and those who have performed unnecessary operations for the sake of the fee."

"Those who split fees, too, I am sure," interposed Carver, who was a Fellow of the American College of Surgeons.

"No," answered Aesculapius, "not unless they have done worse things than that. Pluto had to build an addition to Tartarus lately; it was getting so dreadfully overcrowded. Some of the most distinguished of your former colleagues are there. But perhaps you would like to see the infernal regions. I have the entrée and will be glad to take you there for a visit. Shall we go now? The entrance is quite near."

He stood up. For the first time Carver noticed that the staff which the little man held in his hand had a living snake wreathed spirally around it.

"Well now, doctor," said Carver, with a shade of nervousness in his voice, "I don't know about going now." He looked at his watch and continued, "Maybe I should do better to leave this visit for another time. My friends will be expecting me back. I want to tell you," he went on hurriedly, as if afraid of being interrupted, "I have enjoyed making your acquaintance and having this visit with you. If you ever come to the United States again, and are near Malad City I'd like you to —" He stopped. He had become suddenly aware that he was alone. At what precise instant the little figure had disappeared he could not say. Carver rubbed his eyes. The afternoon was far advanced. The sun was sinking behind the snowy top of Olympus. He knew he would have to start at once if he were to reach his camp before nightfall. He stooped to pick up his walking stick which had fallen upon the ground. As he did so a snake which was lying beside it, and partly over it, glided swiftly away.

¹ "Arrived, they first grim Cerberus survey
Stretched in his den th' enormous monster lay.
His three wide mouths, with many a dreadful yell
And long, loud bellows shook the realms of hell.
Now, o'er his neck the starting serpents rose
When to the fiend the dame a morsel throws.
Honey and drugs, and poppy juices steep
The temper'd mass with all the powers of sleep.
With three huge gaping mouths, impatient flies
The growling savage, and devours the prize.
Then by the charm subdued, he sunk away
And stretched o'er all the cave, the slumbering
monster lay."

(Virgil: Aeneid. Bk. vi, 11, 420 et seq.
Christopher Pitt's translation.)

² "One of the regions of hell, where according to the ancients, the most impious and guilty among mankind were punished." (Lampriere's Classical Dictionary.)



To one not having access to the larger and more complete works on proctology, this work will be found valuable for quick reference.

FRACTURES OF THE JAWS. By Robert H. Ivy, M.D., D.D.S., F.A.C.S., and Lawrence Curtis, A.B., M.D., D.D.S. 180 pp. Phila., Lea & Febiger, 1931.

This is a comprehensive monograph that wastes no words but takes one point and covers its subject thoroughly and plainly. The wide experience of the authors is shown in every page and the illustrations leave little to be desired. For dentists, in particular, this monograph will be of great value.

MALIGNE PHARYNX UND LARYNX-TUMOREN (Malignant Tumors of the Pharynx and Larynx). By A. Zuppinger. With a foreword by Prof. Dr. H. R. Schinz. 188 pp., with 33 illus. in the text and 9 tables. Leipzig, Georg Thieme, 1931. This is Supplementary Volume 40 of the *Fortschritte auf dem Gebiete der Röntgenstrahlen*, ed. by Prof. Dr. R. Grashey.

First, the author discusses the normal anatomy and histology of the larynx and pharynx, a knowledge of both being requisite for the proper management of tumors of these organs. Biopsy is of great importance since upon the histological characteristics depends the plan of radiation therapy. Of 257 pharyngeal tumors, 12.4 per cent involved the epipharynx; 40.9 per cent the mesopharynx; and 46.7 per cent the hypopharynx. Only 23 cases of tumors of the interior of the larynx were observed. Of the total of 280 tumors studied there were 20 cases of sarcoma: 10 of the epipharynx, 8 of the mesopharynx and 1 each in the hypopharynx and larynx. Of the 280 cases 68 were still in an operable stage. There were 82 cases without metastases. The treatment was surgical in the operable cases, combined in some with radiotherapy; the remainder were treated with radiation alone.

Eleven cases are symptom-free from fifteen months to nine years. Seventeen cases were symptom-free but have developed recurrences. Fifty cases, although not tumor free, were favorably influenced; that is, there was an improvement lasting more than three months. In 120 cases there was no favorable effect.

Thirteen cases were not treated. The divided-dose, prolonged treatment method after Coutard is recommended by the authors.

A lengthy bibliography is appended.

The whole presentation is an excellent example of German thoroughness in presenting full details without hesitating to publish the bad as well as the good results. A series of exquisitely printed microphotographs terminates the work.

ARTIFICIAL SUNLIGHT, Combining Radiation for Health with Light for Vision. By M. Luckiesh, D. Sc., Director, Lighting Research Laboratory, Edison Lamp Works—National Lamp Works, General Electric Company, Nela Park, Cleveland, Ohio. Pp. 254. New York, D. Van Nostrand Company, Inc., 1930.

The author submits that besides the field of radiation therapy in the cure of illness, which should be the exclusive territory of the medical profession, there is the important aspect of health-maintenance to which it is the responsibility of every art, science, and individual, able to do so, to contribute.

An important point emphasized by the author relates to the folly of non-luminous radiators for heating bodily tissues at a depth. Water is practically opaque to infra-red between a wave length of 14,000 and 80,000 Angström units. Such energy cannot penetrate bodily tissue. Water becomes transparent again to radiant energy between 80,000 and 500,000 Angström units, but the temperature necessary for such radiation can scarcely be used on the human body.

This work is an excellent and extremely useful treatise on the effects of radiant energy, coordinated with the physics of the subject in a manner calculated to be helpful to physiologists, biologists, and the medical profession, as well as to the physicists, engineers and others interested in lighting problems. The viewpoint of the book is particularly directed toward the health-maintaining value of radiant energy in addition to lighting for vision.

LEHRBUCH DER RÖNTGENSTEREOSKOPIE (A Text-Book of Roentgenstereoscopy). By Dr. Max Cohn, Director of the Roentgen Department of the Stadt Krankenhaus in Friedrichshain, Berlin, and Dr. Walther

Barth, Physicist to the Agfa-Filmfabrik, Leipzig. With 193 illus. in the text and 2 tables of detachable stereoroentgenograms. Pp. 323. Leipzig, Georg Thieme, 1931.

In view of the growing employment of stereoscopy in roentgenography, the authors determined to place in print an authoritative account of the physical basis of stereoscopic vision; an historical survey, in which they refer to Case's early efforts in stereoroentgenography of the alimentary tract, and a very complete description of the apparatus and methods of application of the stereo principle to practically every phase of roentgen diagnosis. There is a lengthy discussion of stereofluoroscopy, with due reference to the pioneer work of Caldwell. It is probably no fault of the authors that they fail to note the success attained by the Medical Department of the United States Army during 1918 in producing a practical stereofluoroscope, for apparently the work in this field was not published. The perfection of the Bucky diaphragm by Hollis Potter has so improved the detail in roentgenograms, which otherwise would hardly be satisfactory as single films but very nice stereoscopically, that some of the need for stereo vision has faded away. However, there is still abundant room for much stereoroentgenography. The book constitutes an encyclopedia of information on the subject, especially if one desires to use the method for accurate third dimension measurements.

CUTANEOUS X-RAY AND RADIUM THERAPY. By Henry H. Hazen, M.D., Professor of Dermatology, Medical Department of Georgetown University; Professor of Dermatology, Medical Department of Howard University; Member of American Dermatological Association, American Roentgen Ray Society. 160 pp., profusely illustrated. St. Louis, Mosby Co., 1931.

The author's effort to write a short, essentially practical book which would aid in the selection of cases for irradiation, has been realized in the text before us. Sane and safe advice is given as to technique, and many pitfalls are warned against. Special warning is given against the dangers of an excessive number of small doses. Following a brief history of the development of roentgen and radium therapy, there is a practical chapter on the

estimation of dosage. We agree with most of the statements made, but physicists will find fault with the statement that the quantity of radiation varies as the square of the voltage. This is not quite true, but there are easily available curves of the intensity rise as the voltage increases, with which the radiologist may orient himself. The author states that stabilizers are not popular among dermatologists; we strongly recommend that they become familiar with the advantages afforded by such device, even in superficial therapy. Since the text of the work was prepared (evidently 1929) a very reliable ionization machine has been devised and is now being widely used, a portable affair, which the reviewer believes every roentgen therapist should employ in the measurement of dosage. We thoroughly agree with the author's insistence upon keeping proper accurate records, and the statement that idiosyncrasy plays a very unimportant part in the production of undue reactions. Some valuable tables, based upon MacKee's formula, are given for unfiltered as well as filtered radiation. The diseases of the skin amenable to radiation, those resistant, and those best treated by radiation combined with some other forms of treatment, are tabulated.

NORMALE UND PATHOLOGISCHE FUNKTIONEN DER VERDAUUNGSORGANE IM RONTGENBILD (Roentgenology of the Normal and Pathological Functions of the Digestive Organs). By Dr. Rudolf Becker, from the Röntgeninstitut of the Theresienkrankenhaus, Mannheim, and Dr. Albert Oppenheimer, Roentgen Section of the University Polyclinic in Frankfort. 144 pp. 255 illus. Leipzig, Georg Thieme, 1931.

This is a very timely and extremely valuable book, the outgrowth of work done at the University of Frankfort. The peristaltic movements of the entire alimentary tract, including the act of swallowing, peristalsis of the esophagus, stomach, small and large intestine, and the physiological and pathological contraction movements of the gall bladder are all included. The section on the colon is extremely interesting and one which ought to be read by every physician who wishes to understand the physiological phenomena relating to intestinal stasis. Many of the clinical puzzles could be solved were the facts so elaborately set forth

in this work understood by the average clinician. This refers particularly to the explanation of cecal stasis. One fault may be found with this work, as with many of the German works in radiology; that the efforts of American colleagues seem to be almost entirely ignored, if we may judge by the references to American work which we find in this book.

ENCEPHALITIS LETHARGICA, ITS SEQUELAE AND TREATMENT. By Constantin von Economo. Trans. and Adapted by K. O. Newman, M.D. London, Oxford Univ. Press, 1931, 200 pp.

This translation of a classic monograph is well done. The author, the translator and the publisher are to be congratulated for making this valuable treatise available to the English reading physician.

For those interested in encephalitis lethargica, this book is indispensable though the average practitioner will probably find the subject adequately covered for his use in the textbooks and systems of medicine. The recent death of Professor Economo lends a special interest to the publication of this translation.

THE INFANT WELFARE MOVEMENT IN THE EIGHTEENTH CENTURY. By Ernest Caulfield, M.S., M.D., with a Foreword by George Frederick Still, M.A., M.D., (Cantab.), Hon. LL.D., (Edin.), F.R.C.P. (London). 8 illus. N. Y., Paul B. Hoeber, Inc., 1931.

Propaganda, having developed into the high art and the mighty one that it is today, has easily led most of us to the assumption that the infant welfare movement is an element of human progress that belongs rather strictly to the twentieth century. A few interested students, however, have taken the trouble to penetrate the fog of modern ballyhoo and have pointed out abundant instances of concerted efforts toward improving the estate of children that occurred in earlier and darker centuries of the Christian Era. G. H. Payne, for example, has written an admirable narration of the growth of foundling hospitals on the continent, these dating back to that established by Datheus, Archbishop of Milan, in 787. Forsyth, Ruhräh, G. F. Still (who has contributed the foreword to Dr. Caulfield's book) and others

have likewise dispelled from the minds of their readers the idea that child welfare never entered the public conscience or consciousness until our own omniscient and compassionate age.

Dr. Caulfield, in this present volume, presents a most vivid and comprehensive picture of some very notable advances that took place in England, more especially in London, in the 18th century.

These advances had little to do with the refined sort of knowledge or method that characterizes the modern science of pediatrics. They were related more closely to a public awakening and a public realization of the value of the life of a child; a change in the public attitude toward the welfare of infants and children. They resulted very largely from the sustained and devoted efforts of a few men with hard minds and soft hearts, men like William Cadogan, Jonas Hanway, Thomas Coram and George Armstrong.

The lot of the child of the early part of the 18th century in England was a miserable one indeed. Infanticide was rife. Neglect, indifference and cruelty were the order. Even among the "quality," children were commonly looked upon as a nuisance and were given over to the care of wet nurses and servants, both because of the fashion of the day and because of the low estimate of a child's value. The mortality below the age of two was about 75 per cent among the general population of children. Among foundlings it was above 90 per cent. The earlier laws and earlier foundling institutions were seized upon by public officials and all manner of low persons as opportunities for exercising diverse chicaneries through which the sorry state of children could be capitalized.

Scenes of this tragic state have been painted for us, dramatically by Dickens, satirically by Swift, and realistically by Henry Fielding, from whom Caulfield has drawn for some of his material. He has drawn as well and with fine discrimination and masterly interpretation from a wealth of literature of that day.

His sketches of the leaders in the infant welfare movements of this period are crisp and informing, that of Jonas Hanway attaining some fine romantic touches. His narration of how these men founded institutions, passed legislation and influenced the public attitude for the welfare of children and transplanted our views on the rearing of children from the realm

of "old wives" traditions to that of scientific observation makes an absorbing story. In their cumbersome style these men were trying to preach what George Ade has epitomized in his own inimitable version: "The hand that rocks the cradle should be amputated."

The illustrations, especially the portraits of Coram, Cadogan and Hanway add measurably to this valuable little book.

THE DIAGNOSIS AND TREATMENT OF VENEREAL DISEASES IN GENERAL PRACTICE. By L. W. Harrison, P.S.O., M.B., CH.B., F.R.C.P.E. Director of Venereal Department, St. Thomas's Hospital. With a chapter on Medico Legal Aspects of Venereal Disease, by F. G. Crookshank, M.D., F.R.C.P. Ed. 4, Oxford Univ. Press, 1931.

That this most excellent text on venereal diseases has been found exceedingly well suited to the needs of the general practitioner is attested by the recent appearance of the fourth edition. An examination of the book reveals ample reason for its popularity. Its matter is limited quite strictly to the practical problems that confront the general practitioner, and the space division corresponds very nicely with the relative importance of the various subjects as met with by the modern physician in general practice.

The arrangement will appear somewhat unusual to those who are accustomed to the American texts. Few American texts, for example, devote so much space to differential diagnosis, or cover such a wide scope of practice. The later American texts, instead of covering all the venereal diseases, and in both sexes, are more apt to be limited to either gonorrhea or syphilis, and if on gonorrhea to concern only the condition in one of the sexes.

The sections on laboratory procedures and interpretations will be found especially helpful to those who are so situated as to be obliged to do their own laboratory work.

The section on the treatment of syphilis is especially comprehensive and includes all the more modern methods of attack on neurosyphilis.

The author exhibits a skillful style that combines clarity and force with a commendable economy of words.

The final chapter, on the medico-legal relations of venereal diseases, by G. F. Crookshank, is somewhat involved, largely because of the perhaps unavoidable use of legal terminology and phraseology. The matter here holds in the broadest principles only in America, since it is treated with the thought of British law in mind. In the other chapters as well, there are occasional references to drugs and methods with which Americans are quite unfamiliar.

The colored plates deserve the highest praise and add measurably to the text.



PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

REGINALD A. CUTTING, M.A., PH.D., M.D., C.M.

TWELFTH INSTALLMENT

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CHAPTER XXI

THE IMMEDIATE TREATMENT OF EXTENSIVE SUPERFICIAL BURNS

Although not connected with the performance of major surgical procedures, the treatment of cases of burns devolves upon the surgeon, and in view of the relatively high mortality rate occurring in connection with the severer degrees of burn trauma, a consideration of the immediate therapy of these cases, as at present understood, is herewith undertaken.

I. BURNS CONSIDERED MERELY AS LOCAL LESIONS

Burns, considered apart from their systemic manifestations, represent a type of lesion scarcely to be differentiated from ordinary wounds; they are characterized by a relatively sudden solution in the continuity of surface tissues, caused not by physical violence, as in the case of ordinary wounds, but by energy of a physico-chemical nature, (1) heat, whether moist or dry, (2) certain chemicals, such as strong acids and bases, phenol, iodine, and phosphorus, (3) actinic radiant energy, as from the sun or from artificial generators like the quartz lamp, and (4) electricity. All of these agents, and possibly others, are capable of producing lesions similar in all essential details to one another, and not dissimilar to ordinary wounds in the process of repair through which they pass during the healing process.

Considered as local lesions, burns differ from ordinary wounds mainly in the fact that they tend to involve large surface areas and consequently, when extensive and deep, to eventuate in excessive, disfiguring, and deforming scar-tissue formation. The time-worn classification of burns into three or more "degrees" seems to serve no really useful function except as it tends to focus the attention of the surgeon in any given case upon the probability of the development of excess scar-tissue formation. A classification of local burn trauma into

two degrees based on the expectancy of scar-tissue formation, (1) superficial, and (2) deep, in accordance with the suggestion of Bancroft and Rogers¹ and others, seems more rational, and may eventually become the accepted nomenclature. Under such a classification superficial burns would include all those which do not eventuate in the complete destruction of the skin epithelium, especially such islands of epithelium, representing hair follicles and coil glands, as lie at a lower level than the stratum germinativum. Obviously, if a sufficient number of such islands remain undestroyed after a burn, they tend to act as natural Reverdin skin grafts from which relatively complete and normal epithelialization may proceed. The deep burns, on the other hand, would be represented by lesions of greater penetration in which epithelialization could not occur except from the edges of the lesion, all islands of epithelium having been destroyed, and which, consequently, invariably would require artificial skin grafting during the process of repair and possibly other surgical measures aimed at the production of satisfactory functional and cosmetic results.

Aside from this very important practical difference between the lesions of burns and ordinary wounds, there is not very much of therapeutic novelty as far as burn lesions are concerned. Hemorrhage and infection tend to present problems in the one as in the other; especially is this true with respect to infection. The possibility of tetanus and gas bacillus infection should be carefully considered.

II. THE FUNDAMENTAL IMPORTANCE OF THE ASSOCIATED SYSTEMIC REACTION, TOXEMIA

The real problem presented by extensive burns is not connected with the local lesion as such, but rather with certain concomitant systemic reactions of toxic nature which in themselves may be sufficiently severe to jeopardize the patient's life.

The severity, as concerns life, of a case of burns depends not so much upon the depth of the trauma or the gross amount of

tissue actually destroyed as upon the *extent* and *location* of the skin area involved. Living skin, when subjected to the trauma known as burning, is capable of developing certain complex chemical by-products, the exact nature of which is unknown, but which are absorbable, and which when absorbed into the circulation produce systemic reactions described collectively as "toxemia." In this respect skin differs from other tissues; the burning of fat, muscle, osseous, and other tissues is accompanied either by a very minor degree of such a reaction or none at all.

The burning of certain particular skin areas seems to be accompanied by the development of severer grades of toxemia than certain other areas of similar extent. This is particularly true of the so-called "blush area," which, as the term implies, comprises the face, neck, and upper torso, especially the anterior part of the chest wall. The rich blood supply of this area and particularly its sensitive vasodilatory capillary system doubtless partly at least accounts for the rapidity and degree of toxic absorption.

Much of our knowledge of the process of toxic absorption has been developed by the researches of Robertson and Boyd.² Characteristically, toxemia develops only when living skin is burned, as is shown by the fact that extracts from burned dead skin, when injected into experimental animals, fail to produce typical toxemia, whereas, if burned living skin be engrafted upon an otherwise normal animal a characteristic toxemia develops.

There is apparently a definite latent period of about eight hours between the occurrence of a burn and the beginning of toxic absorption, since it has been shown experimentally that if complete excision of a burned skin area be performed within such a period, the toxic constitutional reaction does not develop, whereas if excision be delayed beyond this latent period, the procedure of excision is without avail. The eight hour latent period of toxic absorption, as just described, represents not the interval beyond the limits of which clinical

symptoms of toxemia may be expected to appear, but only the period beyond which the surgical eradication of the local lesion can no longer be depended upon to prevent the subsequent development of toxemia. The clinical symptoms of toxemia do not ordinarily appear for from twenty-four to forty-eight hours, or even longer, after the infliction of a burn.

That the development of burn toxemia depends upon absorption of toxin by way of the blood stream is apparently demonstrated by the fact that the development of such a toxemia does not take place if the vascular drainage from the involved area be interrupted by ligation of afferent blood vessels. Furthermore, evidence has been adduced to show that the absorbed toxin is carried mainly either within or absorbed to the red blood cells, since, whereas whole blood derived from burned animals, when injected into normal animals is toxic for them; blood serum, on the other hand, is found not to be toxic except in relatively large doses.

The fundamental nature of burn toxemia is very imperfectly understood, but certain of its clinical and post-mortem changes have been investigated with considerable care, and not a little information has been gained thereby.

A. BLOOD CONCENTRATION: The development of burn toxemia is accompanied by a very definite concentration of the blood in the more severe cases, and this concentration has been found clinically to vary directly with the severity of the burn.

Blood concentration is most conveniently estimated clinically by means of hemoglobin determinations; Underhill³ has reported clinical increases to 145 per cent and Ravdin⁴ to 125 per cent of normal. This blood concentration in the more serious cases is capable in itself of causing death, because such degrees of viscosity lead to impairment of capillary circulation, diminished oxygen-carrying capacity of the blood, lowering of temperature, suppression of urinary secretion, and suspension of the vital activities.

Locke⁵ analyzed the erythrocyte count in 9 cases of severe burns, and found that in 5 cases in which the count exceeded

9,000,000 to the cubic millimeter all the patients died, whereas the other 4 patients, in none of whom did the count exceed 7,260,000, recovered. Similarly, Underhill,³ studying 21 clinical cases of burns, found that in cases regarded as "serious" the hemoglobin content was always more than 125 per cent of normal. This author reports 1 exceptional case in which the hemoglobin content reached the astounding figure of 209 per cent. Pack⁶ believes that the maintenance of a 40 per cent increase in the hemoglobin is inconsistent with life.

B. CHLORIDE RETENTION: According to the researches of Underhill, which have been amply confirmed by other investigators, the blood chloride content of the blood in burns is characteristically considerably reduced. The reduction in severe cases may be of the order of 50 per cent; figures of 250 mg. or even 200 mg. of chlorides to the 100 c.c. of plasma are not of very infrequent occurrence. This reduction of the blood chlorides is not accompanied by a corresponding urinary chloride excretion; in fact, the very opposite effect occurs, the urine showing a markedly decreased chloride output. Only one explanation for such a state of affairs is evident, the occurrence of "chloride retention"; furthermore, the chlorine radical, not being present in normal amounts either in the blood or the urine, must have been stored in some of the fixed tissues of the body. It is generally assumed that such storage represents a conservative process in which the chlorine radical combines with the primary toxic materials elaborated in the burned tissues and subsequently absorbed into the blood stream in such a manner as to render them innocuous. This theory corresponds with the observed facts in that excessive chloride excretion occurs at the end of the toxemic period, i.e., at the time of the separation of sloughs. In lobar pneumonia is found a close analogy in that during the height of the disease there is marked chloride retention, but after the crisis excess chloride excretion.

Davidson⁷ has shown that the lowering of the plasma chlorides is proportionate to the amount of tissue devitalized and

persists as long as sloughs remain. Possibly the disappearance of the chlorides from the blood stream accounts at least in part for the blood concentration observed clinically, since a large part of the osmotic tension of the blood stream is dependent upon its chloride content, 60 per cent according to Howell.⁸ Barach⁹ has determined that the intravenous injection of 100 c.c. of 15 per cent sodium chloride solution is capable of increasing the total blood volume by 500 to 1200 c.c.

C. BLOOD SUGAR VARIATIONS, ADRENAL CHANGES: At autopsy on patients who have died from extensive burns the adrenal glands are found to be from three to five times normal size, and both the epinephrine content of the medulla and the lipid content of the cortex are markedly decreased (Weiskotten¹⁰ Olbrycht¹¹). On microscopic section the glands show definite degenerative changes.

Blood sugar estimations on specimens of blood taken from such cases during the agonal period may be very low. Greenwald and Eliasberg¹² performed a series of experiments on rabbits which indicate that early in the development of cases of burns (one and a half hours after the infliction of such a lesion) the blood sugar concentration may be very high, a phenomenon apparently due to excess stimulation of the adrenal medulla, since the medullary tissue microscopically shows evidence of excessive activity. This occurs at a time previous to the development of toxemia as determined both clinically and experimentally, and therefore, must represent no essential part of toxemia as such; the phenomenon seems to be closely related to the severity of shock. Later, however, microscopic changes in the medulla are found, suggestive of exhaustion, and during this period in severe cases the blood sugar is found to be correspondingly low; these changes occur primarily in the period, clinically and experimentally, characterized by toxemia.

D. OTHER METABOLIC AND TISSUES CHANGES: Additional tissue and metabolic changes have been noted, which, so far as is now known, are of relatively minor importance. Degenera-

tive lesions have been described at different times in various parenchymatous organs, liver, spleen, pancreas, and other tissues. Most pathologists regard these as largely adventitious. The occurrence of ulceration in the gastrointestinal tract as a complication of burns i.e., the so-called Curling's ulcer is probably less frequent than usually believed. Novak¹³ estimates the incidence in fatal cases at 5 per cent. Ronchese¹⁴ saw only 1 case in 348 autopsies. Ecchymotic patches on the small intestine, both subserous and submucous, are commonly found, at least experimentally.

Apparently changes in the acid-base balance of the body are not characteristic of burn toxemia as such; they may occur as more or less accidental complications of blood concentration or excess chloride administration. The same applies to disturbances in protein metabolism; whereas increases in the non-protein and urea nitrogen of the blood do characteristically occur, they are usually not particularly significant, and can probably be explained in most or all cases solely on the basis of blood concentration. Albumin and casts are more or less constantly demonstrable in the urine of burn cases, but appear to be solely dependent upon blood concentration; the kidney parenchyma is ordinarily not demonstrably damaged.

E. CLINICAL MANIFESTATIONS OF BURN TOXEMIA: As previously mentioned, the clinical manifestations of toxic absorption usually appear only after twenty-four to forty-eight hours. They consist of:

- (1) Elevation of temperature
- (2) Rapid pulse
- (3) Vomiting
- (4) Drowsiness or delirium

The development of such symptoms and the development of the previously described underlying pathology may be expected to occur in all cases of excessive burns, even though very superficial. In this respect, the real seriousness of burns is apt to bear no particular relation to the problem presented by the actual local lesion.

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Pack¹² considers as serious all burns deeper than first degree which involve one-tenth or more of the body surface. Burns deeper than first degree which involve more than one-third of the body surface may result fatally, and those involving more than two-thirds usually do result fatally in adults. Much less extensive burns in children often result fatally.

The estimation of the severity of burns in accordance with their extent relative to the total body surface is, of course, a rather inaccurate method, but one which suffices well enough for determining the severity in ordinary clinical cases. In any actual estimation some fairly accurate method of judging the surface extent of various component parts of the body becomes desirable.

Berkow¹³ has estimated the distribution of body surface area as follows:

	Per Cent
Lower extremities including the buttocks	35
Trunk including neck	38
Upper extremities	18
Head	6
	100

The hand accounts for one-fourth of the surface of the upper extremity. The foot accounts for one-sixth, the leg one-third, and the thigh one-half of the surface of the lower extremity. Estimations based on such a schema as this seem to present rather obvious advantages over mere random judgments.

III. TREATMENT

The treatment of cases of burns may be artificially divided into two parts, (1) the treatment of the local lesion, and (2) the treatment of the systemic reaction; but theoretically and actually such a division is not a convenient one, because the degree of toxic absorption depends very largely upon the efficiency of the treatment accorded the local burned area.

A. SHOCK: In the early stages of burns, i.e., before the end of eight hours, toxic absorption has not yet occurred, and the

gravity of the patients's condition is largely dependent upon the degree of shock present. The condition of shock occurs frequently in connection with burns, especially those of a more severe nature, and unless the condition be recognized and accorded successful preliminary treatment, the patient's chances of recovery may at least be jeopardized, and in extreme cases such an oversight may actually prove fatal.

There is a real danger that the general condition of the patient at the time of being first seen will quite escape the attention of the medical attendant in his zeal to do something locally, if he possesses the information that the local wound is the source of the toxemia and is attracted to this area by the silent or expressed entreaties of both the patients and their friends. No undue anxiety need be felt, however, in the usual case of thermal burns to hasten in the matter of local treatment, since a number of hours of grace are allowed by Nature before the beginning of the onset of the other main factor in mortality, "toxemia."

Formal treatment directed toward the relief of local conditions is highly irrational in the presence of shock. The truth of this contention is altogether too rarely appreciated, and it is no uncommon sight in some hospitals to observe the uninitiated, painstakingly laboring with the removal of clothing, puncturing, and cutting away blebs, and washing away contaminating debris, while the patient's systolic blood pressure is less than 70, 60, or even 50 mm. of mercury, and the exposure incident to the manipulation is constantly aiding in the further dissipation of heat from a body which already manifests a subnormal temperature. The shock of hasty and unwise local treatment added to the shock already present as the result of the original burn trauma, undoubtedly precipitates many a needless death.

The treatment of burn shock differs in no essential particulars from the treatment of shock otherwise induced, the essential features being the administration of large doses of morphine, the maintenance of the body warmth by the applica-

tion of external heat in the form of a light tent or hot water bottles and internal heat in the form of warm drinks or intravenous infusion, the lowering of the head to combat cerebral anemia, and the promotion of quiet and rest under the watchful eye of a competent attendant. During this period the local trauma may be completely disregarded except for the prevention, so far as is feasible, of adventitious local contamination; for this purpose the wounds may be simply covered with a sterile sheet or towels. It is again emphasized that toxic absorption does not occur for several hours, a period of time ample both for the treatment of the shock and for the institution of suitable additional treatment after the period of shock has passed.

Two important exceptions to this discussion must be mentioned in passing:

(1) In those cases in which the patient's clothing has caught fire the utmost care must be exercised immediately after the patient is seen to make sure that no smoldering material has been over-looked in the excitement of transporting the patient to the medical advisor.

(2) In attending cases of chemical burns one peculiarity of the traumatizing agent must be remembered; a prolongation of action is maintained until neutralization of the active agent is accomplished, either by natural or artificial means. Patients burned by chemicals should be quickly treated locally to assure complete neutralization of the chemical reagent before anything else is done. The neutralizing property of alcohol in connection with phenol burns can be invoked immediately. In most other cases copious gentle washings with water is indicated, after which application of a neutralizing agent may be employed, weak acids for strong bases, and vice versa.¹⁷

B. LOCAL THERAPY: 1. *Debridement*: Granted that chemical reagents have been successfully neutralized and shock has been found absent or has been successfully combated, the attention of the medical attendant is, naturally, next focussed on the local lesion. In accordance with what has been developed of the therapy of wounds of other kinds, it would, at first thought, appear rational to perform complete debridement, thus converting the contaminated wound into a clean one. Such a

procedure has, in fact, been warmly advocated by Brager, Lewis, MacKenzie, and others.¹⁸ For the purpose of debridement the patient is placed under a general anesthetic, and after the patient's clothing over and surrounding the burned area has been cut away, or otherwise carefully removed, the latter area is either thoroughly scrubbed with a sterile scrubbing-brush and sterile water or saline solution until the area is completely clean, or else resort is had to various sharp instruments for the removal of the contaminated tissue, amputation knives, razors, curettes, and scissors,

2. *Simple Removal of Devitalized Tissue:* Whereas such heroic therapy is undoubtedly the treatment of choice in connection with the deep charring of a limb or in cases of other deep burns of limited extent, one of the usual characteristics of burn trauma is that it is extensive, though superficial, and one of the complications most to be feared is the subsequent formation of excessive scar formation with its train of contractures and series of plastic repairs. So important is this matter that it is usually considered not only proper, but necessary, to preserve as much of the undamaged epithelial covering of the traumatized area as possible, from which epithelial proliferation may subsequently proceed, in order that scarring may be reduced to a minimum. Accordingly it seems best to make an exception of burns in the matter of debridement and to be content with a macroscopic cleansing of the burned area without attempting the removal of any healthy tissue that may subsequently be utilized by Nature in the process of repair.

Frequently, in the severe type of cases, the patient may be placed in a bathtub filled with warm water and the clothing gently soaked and cut away; in cases less severe it may be possible by gentle manipulation to dispense with any such formal procedure and attack may be launched upon the traumatized area directly, loose skin being stripped away with sterile forceps, particles of dirt being carefully removed likewise, blebs being punctured and cut away with scissors and the

entire area being finally thoroughly cleansed with some non-irritating fluid like normal saline solution or benzine, the latter substance being particularly grateful as far as the patient's sensations are concerned, and at the same time being somewhat antiseptic; in the very severe cases, on the other hand, the proper performance of the preliminary cleansing may not be attempted in the absence of general anesthesia, and in such cases no hesitation should be felt in taking the patient directly to the operating room and making the process as formal as may be necessary to ensure thoroughness.

3. *Tanning*: Undoubtedly the toilet of the local lesion serves as a valuable prophylactic precaution against the development of subsequent toxemia, but inasmuch as much material of toxic nature is, of necessity left behind, some method of further preventing absorption is desirable and this, fortunately, has been provided in the process of chemical fixation of this material *in situ*. Various substances have been suggested for this purpose, amongst which may be mentioned absolute alcohol, picric acid, and "aluminium aniline," but since 1925 the method of tannic acid fixation has become virtually standard to the exclusion of all others. This method was first promulgated by Davidson¹⁹ and seems most completely to meet the indications. In this method a true tanning process fundamentally similar to that used in the preparation of leather is employed.

A watery solution of tannic acid of a strength between 1 and 5 per cent has been advocated; possibly the best results follow the use of a 2 or 2.5 per cent solution. Tannic acid keeps indefinitely in powder form, but in solution fairly rapidly changes into gallic acid, which is unsuitable for the purpose now being described, and consequently solutions of tannic acid should be freshly prepared as needed. Inasmuch as tannic acid solutions are antiseptic by virtue of their protein coagulating properties they require no preliminary sterilization, though it is well to take the precaution of using sterile water in the preparation of the solution in order to avoid gross contamination.

The application of tannic acid solution to the traumatized area may be made either by means of wet gauze compresses or by spraying the solution directly on the area, according to the



FIGS. 64 and 65. Two views of a patient being treated for superficial burns of chest and abdomen by tannic acid method; area has been thoroughly tanned and crust partly dried.

FIG. 64. A close-up; note expression of comfort on patient's face. Demarcation line between tannic acid crust and normal skin is sharp, showing that tannic acid has no effect on vital tissue.

choice of the operator or the facilities at hand. An atomizer of the type commonly used for spraying the nose and throat makes a very suitable spraying device, and almost any available sterilized gauze squares may be used for making compresses: squares about 10 to 12 in. on a side and 8 to 10 layers in thickness when loosely wrung out of the solution and spread over the burned area make excellent compresses.

In the application of the solution by either method the aim is to keep the burned surface continually moist with the solution. The solution evaporates from the skin when applied by means of an atomizer in about twenty minutes, and gauze

compresses become unduly dry in about half an hour; consequently, renewed application of solution is required at the end of these respective time intervals.

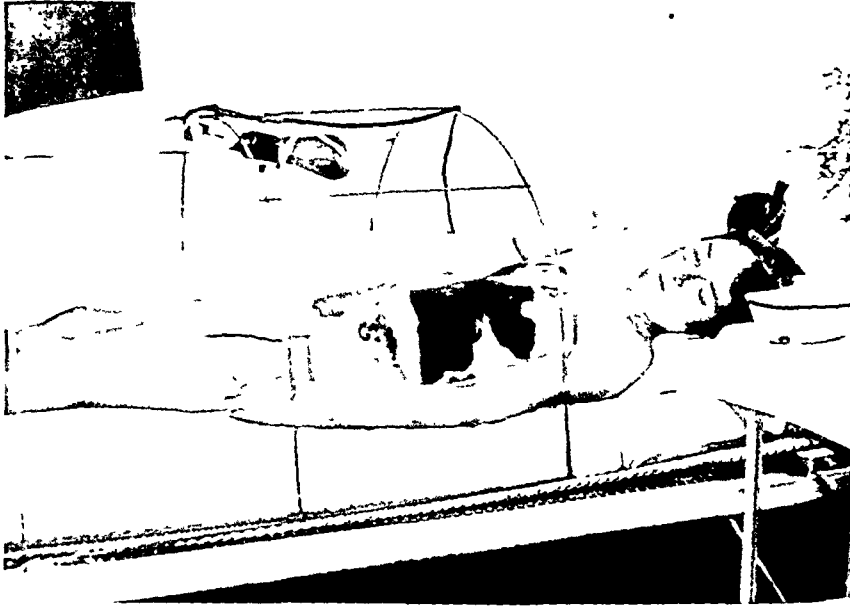


FIG. 65. Patient went to sleep during photography. A wire heat-tent is in place; note extension cord and electric light socket fastened to tent by adhesive plaster. A simple arrangement of this kind is all that is required. The bedclothing will be draped over the heat-tent.

The electric light tent serves as an excellent device for holding the bedclothing away from the patient, thus facilitating the manipulations incident to the application of tannic acid. It is no less valuable in relieving the pressure of bedclothing during the preliminary treatment of shock or yet again during the process of drying the tanned area, immediately to be described; in both of the latter mentioned stages of treatment, in addition to acting as a support for the relief of pressure, it also serves for the application of heat.

Tannic acid unites with devitalized tissues to form a complex protein-tannate, but normal tissues resist this action, and

for this reason the action of tannic acid on the normal margins of burned areas presents no problem.

Tanning of burned areas is usually complete in from sixteen to twenty-four hours, the method of spraying being somewhat more rapid in its action than the compress method. When tanning is complete the traumatized area presents a uniform mahogany-brown color and is, of course, thoroughly moist; indeed, when the compress method is used a thorough moistening of gauze packs should precede their final removal lest portions of tissue which have become partially adherent through drying be inadvertently torn away with the gauze.

During the process of tanning the toxic products caused by the burn trauma are partly imprisoned within the tannate coagulum and toxic absorption is thereby lessened; however, cessation of absorption occurs only when the tanned area has been subjected to a process of thorough drying; and for this reason desiccation should be instituted without delay as soon as the full action of the tannic acid has been realized. Drying is most conveniently achieved by utilizing the electric light tent and keeping the temperature beneath the tent at 100° F. or slightly more, the patient himself being naked at least as far as the involved area is concerned. Under these conditions drying is complete in twenty-four hours or somewhat longer, depending to a considerable extent upon the depth of the burn being treated. When dry, the tanned area presents a hard, leathery, dark brown or black crust or splint fashioned out of the patient's own tissues (Figs. 64 and 65). This crust performs three important functions apart from the prevention of toxic absorption:

(1) It protects sensitive nerve ends from extremes of temperature and mechanical stimulation, thereby ensuring to the patient relief from pain. Patients lie on the crust in perfect comfort.

(2) It interposes an impervious barrier between tissue spaces and injured tissue cells, and the external air thereby preventing evaporation of tissue fluids and exudates. This is important in connection with the dehydration found characteristically in burn toxemia.

(3) It serves as a protective covering for young granulation tissue and new epithelium during the process of repair.

On the other hand, the crust may occasionally become objectionable due to the formation of pus below its surface. No method, with the single exception of rigid debridement, can entirely prevent the development of suppuration, and the tannic acid treatment, therefore, simply shows this limitation in common with other methods; however, when suppuration does occur under tannic acid therapy, it does so comparatively late as far as the period of toxemia is concerned, and no hesitation should be felt in cutting away the crust for purposes of drainage. The crust is conveniently softened prior to removal by treating it for a short time with liquid petrolatum; thereafter it can be easily cut with a knife or scissors.

Infection should be conveniently kept at a minimum in the treatment of burns by the use of tannic acid by virtue of the very nature of the method. Tannic acid, as previously noted, is, to a degree, antiseptic, and unless grossly infected material be covered over during the process of tanning widespread suppuration should not ordinarily occur. In applying the method the ordinary surgical principles with regard to "contamination" and "infection" should be borne in mind. For a period of eight hours or so following any trauma organisms which may have found their way to the traumatized area do not ordinarily penetrate tissues to any considerable extent. This is because they have not yet had time to excite sufficient tissue reaction to call forth the characteristic leucocytic response in accordance with which they become engulfed in the actively motile polymorphonuclear cells and transported deeply into the tissue spaces and the local lymph stream. Accordingly, if burns are seen and treated early, virtual sterilization of the traumatized area should be the rule.

A rather homely but practical emergency suggestion has been offered in connection with the tannic acid treatment of burns by Shen.²⁰ If tannic acid, as such, be not readily available an infusion of tea serves almost as well; about 8 gm. of tea per

100 c.c. of water when boiled for fifteen minutes make a suitably strong solution of tannic acid.

The many other methods of local treatment in burn trauma which have been described from time to time in the past are of value in direct degree as they fulfil the main indications so admirably met by the tannic acid treatment, (1) prevention of toxic absorption, (2) prevention of infection, (3) prevention of pain, (4) prevention of dehydration, and (5) protection from trauma. None of them will be here described, however, because none of them sufficiently well meet the indications to make them of any considerable value in serious cases.

C. CONSTITUTIONAL TREATMENT: Theoretically the fixation by coagulation of toxins in the traumatized area in burn cases should prevent the subsequent development of toxemia, and systemic treatment should not, therefore, be required except for primary shock and hemorrhage. Unfortunately, this ideal condition is never achieved practically. Many burn cases are seen too late for the adequate prophylactic treatment of toxic absorption; those which are seen early and are properly treated do not respond according to theoretical consideration, and complications, especially infection, frequently induce profound systemic effects. For these reasons the systemic treatment of burns generally bulks large.

1. *Blood Transfusion*: The therapeutic possibilities of blood transfusion should always be kept in mind not only in the early stages of shock but also later in connection with the development of toxemia and sepsis.

Davidson²¹ transfuses all patients who have received a possibly fatal burn, and in all cases which develop shock the transfusion is repeated.

The heroic "exsanguination transfusion" of Robertson and Boyd^{22,23} may occasionally save a life but is rather radical therapy in view of its unproved value.

2. *The Value of Water and Sodium Chloride*: The administration of water and sodium chloride in comparatively large quantities constitutes the surgeon's sheet anchor in the pres-

ence of actual or anticipated toxemia; 4000 to 5000 c.c. of fluid in the course of twenty-four hours, whether by mouth, proctoclysis, hypodermoclysis, or infusion, is an amount none too little to administer to an adult in a state of threatened or developing burn toxemia. Sodium chloride is conveniently added to proctoclysis, hypodermoclysis, or infusions in such proportions as to make an isotonic or even slightly hypertonic solution (up to 2 per cent). Sodium chloride is, of course, poorly tolerated *per os*.

The adequacy of the treatment can be determined solely by laboratory tests; hemoglobin estimations or total erythrocyte counts are urgently demanded every three to four hours in severe cases undergoing active treatment, and plasma chloride determinations every six to eight hours are also indicated in these cases. Unsatisfactory reduction in abnormal values demands immediate reduplication of energy in the appropriate direction, either administration by one or more additional avenues of water and sodium chloride, or in the case of the latter substance, increase in concentration.

3. *The Use of Adrenalin and Dextrose:* In accordance with experimental considerations blood sugar determinations should be made in conjunction with chloride determinations, and when unduly low sugar values are encountered either adrenalin or dextrose should be supplied. The exhibition of adrenalin has not been proved to be of clinical value, and it is a relatively dangerous drug when incautiously handled. There seems to be no good reason, however, for withholding dextrose, and every surgical principle seems to indicate the maintenance of the blood sugar level at a normal figure by the adequate exhibition of this substance.

4. *Physical Therapy:* It is quite possible that the light generated in an electric light tent may have some value *per se* in the treatment of burns. Kessler²⁴ has reported excellent results following the application of light from the ultraviolet and radiant heat lamps in the absence of other treatment, and although such therapy alone cannot be regarded as adequate

for severe burns or even burns of less severity the possible value of actinotherapy as an adjunct to treatment by other methods is strongly suggested. Ultraviolet light is advocated because of its supposed value in the prevention of scar tissue formation and the radiant heat lamp for its penetrating action and stimulating effect on the circulation. The ultraviolet lamp itself, however, when handled indiscretely is capable of causing severe burns. In general, it may be said that the entire subject of phototherapy needs to be placed upon a more secure scientific basis before it can receive the measure of endorsement to which it is probably entitled.

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CHAPTER XXII

THE TREATMENT OF ACUTE TRAUMATIC
CRANIOCEREBRAL INJURIES

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CHAPTER XXII

THE TREATMENT OF ACUTE TRAUMATIC CRANIOCEREBRAL INJURIES

I. THE RELATIVE IMPORTANCE OF INJURIES TO THE CONTENTS OF THE SKULL AND THE RELATIVE UNIMPORTANCE OF SKULL FRACTURES AS SUCH

Although it is, of course, true that many or, indeed, most cases of head injuries are not nowadays submitted to formal operative procedures as a part of their treatment, such cases fall within the field of general surgery and, depending upon circumstances, may require operative intervention either soon after they are first seen or at varying intervals of time subsequently. Accordingly, it falls to the lot of the surgeon not only to assume care of such of these cases as present immediate indications for surgical procedures but also to observe and to treat such cases as progress, on the one hand, to complete recovery under conservative therapy, or, on the other hand, in spite of such therapy, to a point at which operative intervention becomes desirable or necessary.

Formerly, the degree of injury to the cranium or bony skull was at least tacitly assumed to be a reliable index of the severity of a case of head injury, those cases in which fractures could be demonstrated being considered less favorable than those in which no fracture could be found, and those with severe or extensive fracture being considered more serious than those with fractures of minor degree. As the result, however, of the researches of such investigators as Cushing, Sharpe, Frazier, Sachs, and others, it is now considered a sound surgical principle virtually to disregard the extent of the bony injury, provided such injury does not demand operative interference for fairly obvious mechanical reasons, and to focus the attention on the internal soft parts injuries the extent of which cannot be gauged directly but only indirectly on the

basis of symptoms, signs, and special methods. The preoperative treatment of the traumatic craniocerebral case, therefore, resolves itself in the average instance into an estimation of the nature and extent of the injury to the brain substance, the meninges, and the accompanying blood vessels, and the application of suitable measures for the relief of the same with a view to obviating the necessity for surgical interference or to alleviating the danger incident thereto in case surgery becomes inevitable.

As representative of the trend of modern practice away from operative intervention and toward conservatism, two series of cases may be compared, the first collected by Sharpe,¹ and the second reported by Weaver:²

Sharpe reviewed the histories of skull fracture cases from three of the large hospitals in New York City during the decade, 1900-1910. The immediate mortality from fracture of the skull was between 46 and 64 per cent. Of those cases submitted to operation 86 per cent died; of the 34 per cent of those recovering and discharged as "well," "cured," or "improved" which could be traced, 67 per cent were still suffering from the effects of the former injury.

In the series of cases reported by Weaver only 36 cases were submitted to formal operation in a series of 125 consecutive serious head injuries, and only 22 deaths resulted.

II. THE SIGNIFICANCE OF THE HISTORY IN ESTIMATING THE SEVERITY OF CRANIOCEREBRAL INJURIES

As an aid in estimating the probable extent of cerebral damage the history of the case is often of considerable value. An estimation of the amount of force probably exerted during the reception of the injury is of importance, since, other things being equal, the amount of the force and the extent of cerebral damage are proportionate. Specifically, elicitation of the history should attempt to reveal:

- (a) In cases of blows upon the head, the nature of the object with which the patient was struck and the amount of force used,

- (b) In cases of gunshot wounds, the kind of shot used, the kind of gun, and the distance from gun to patient,
- (c) In cases of automobile, street car, and train injuries, the speed at which the vehicle was travelling and the position of the patient at the time of the accident,
- (d) In cases of falls, the probable distance of descent and the position of the patient on alighting.

Various presumptive evidences of the probable extent of trauma should also be considered; whereas loss of consciousness usually indicates a relatively severe degree of trauma, and the longer the period of unconsciousness the more severe the injury,³ the occurrence of previous attacks of faintness, indicating possible cardiovascular disease, convulsions, indicating possible epilepsy, diabetes, and uremia, should at least suggest the consideration of other possible etiological factors in the causation of loss of consciousness.

In eliciting the history, special attention should be paid to the presence or absence of the so-called "meningeal syndrome," which consists of (a) a period of unconsciousness followed by (b) a period of lucidity, and followed, in turn by (c) a period of deepening coma.

Such a train of symptoms usually indicates injury to the middle meningeal artery, typically the posterior branch, accompanied by the formation of a hematoma between the dura and the skull.

The intermediate lucid interval in cases of laceration of the middle meningeal artery may last for a period of hours or days, depending, of course, upon the size of the vessel injured and the degree of adherence of the dura to the skull in the involved area. The period of unconsciousness is ushered in by headache, vomiting, and drowsiness which gradually deepens into coma; the blood-pressure rises, and a dilated pupil is found on the affected side. The spinal tap characteristically shows only a clear fluid under some increase of tension, the hemorrhage being extradural.

III. THE PHYSICAL EXAMINATION

In the physical examination of a victim of a head injury, before proceeding to any local examination of the head, one should not omit to recognize "shock" if present, since on the one hand, patients may die of shock alone, and, on the other hand, patients subjected to the trauma incident to even minor operative manipulations during the period of shock present a very high mortality rate. Other things being equal, severe shock may be interpreted as indicating severe injury.

The local examination of the head should embrace the following especial considerations:

(1) The nature and extent of lacerated and incised wounds of the scalp with an estimation of their probable depth and probable involvement of the cranium; sometimes the local escape of brain substance or of cerebrospinal fluid will make the latter clear.

(2) Evidence of injuries to the skull and brain not connected with scalp wounds, especially the presence of abnormal swellings and depressions (depressed fracture).

(3) Evidences of fracture of the base of the skull, especially as shown by examinations of:

(a) *eyes*: subconjunctival hemorrhage and ecchymoses about the upper and lower lids, pulsating exophthalmos,

(b) *ears, nose, and mouth*: bleeding, escape of brain substance or cerebrospinal fluid, which always indicates basal fracture in the absence of evidences of obvious external trauma,³

(c) *mastoid process*: ecchymoses and edema ensuing usually about twenty-four hours after injury (Battle's sign), which indicates local fracture,

(d) *pupils of the eyes*: equality of size, dilatation or contraction, and reaction to light and distance.

(4) Skiagrams, including at least anterior-posterior and lateral views for the purpose of visualizing the position and extent of any possible fractures present, but always bearing in mind that as an aid in the discovery of basal fractures the x-ray method is exceedingly untrustworthy.

In the interpretation of physical findings, apart from the simpler signs which are capable of fairly direct explanation much confusion and difficulty will be avoided by attempting to visualize the special pathological physiology involved in head

injuries. The characteristic symptoms and signs are dependent upon compression of the brain substance; occasionally this may result directly from the local inward collapse of a section of the skull, but in by far the greater number of cases the compression is indirect and secondary (1) to intracranial hematoma formation, (2) to reactionary changes in injured brain tissue, the formation of edema, or (3) interference with the normal circulation of cerebrospinal fluid.

IV. PATHOLOGICAL PHYSIOLOGY OF INCREASED INTRACRANIAL TENSION

The coverings of the brain, except in the very young child, are incapable of any measurable expansion at all, expansion being prevented (1) by the bony protective covering, the cranium, and (2) by the dense and relatively inelastic dura mater which is also inexpandible even in cases in which the bony supportive envelope has been injured. The normal contents of the skull consist, of course, of (a) the brain substance, (b) the blood vessels, arteries, capillaries, veins, and venous sinuses, together with their contents, i.e., venous and arterial blood, and (c) the cerebrospinal fluid contained in the ventricles and subarachnoid spaces.

Encroachments upon the capacity of the skull from any cause increase the intracranial tension, forcing out of the cavity the cerebrospinal fluid, which is under relatively low tension (8 to 10 mm. of mercury), and the venous blood, which is also under relatively low tension, the former through the foramen magnum into the subarachnoid space of the cord, and the latter by the efferent veins into the general circulation. The amount of expansion which the brain tissue can obtain at the expense of these fluid contents of the skull or the amount of space which can be usurped by foreign material, such as blood clot, is strictly limited, however, for, as the fluid contents are displaced, the tension within the cranium progressively increases and eventually either the pressure becomes so high as to prevent the ingress of sufficient arterial blood to maintain

the function of the vital centers, or these centers become paralyzed by mechanical pressure and the patient succumbs.

Thus, during the process of expulsion of the *cerebrospinal fluid* and of the *venous blood* relatively little clinical change occurs in the condition of the patient; when, however, the intracranial pressure becomes sufficiently high to force arterial blood out of the capillaries, arterioles, and arteries, the vital centers begin to suffer acutely as a result of curtailed oxygenation and a compensating mechanism is brought into play which consists of the intake of increasing amounts of air by the lungs and an increase in the arterial tension.

Among the traumatic lesions which are directly capable of producing a restriction of space in the cranial cavity may be mentioned in addition to depressed fractures of the skull:

- (1) Extradural hemorrhage, i.e., hemorrhage which occurs between the cranium itself and the dura, as for example, in rupture of the middle meningeal artery and more rarely rupture of the venous sinuses,
- (2) Subdural hemorrhage,
- (3) Subarachnoid hemorrhage,
- (4) Subpial hemorrhage,
- (5) Intracerebral, intracerebellar, or intramedullary hemorrhage or edema,
- (6) Intraventricular hemorrhage,
- (7) Increased secretion or defective absorption of cerebrospinal fluid indirectly due to trauma.

Certain of these lesions, like subdural hematoma and depressed fracture, rather obviously are capable of producing mainly localized pressure, whereas, others like cerebral edema produce mainly diffuse pressure.

As a result of trauma to the brain, its tissue, like other tissue, undergoes certain reactive changes, among which is swelling, due to outpouring of serum and cells into the tissue spaces of the injured area; the swelling of brain tissue, however, as previously mentioned, can take place only at the expense of fluid contents capable of displacement, since increase of the

cubical contents of the cranium is impossible, and consequently any injury to brain substance, whether or not primarily localized, also becomes ultimately more or less diffuse.

Only in the more severe or later stages of craniocerebral injuries, however, does this sort of edema occur, the so-called "fixed edema." The usual type of cerebral edema is probably represented almost entirely by disturbances of the secretion and absorption of cerebrospinal fluid.

The cerebrospinal fluid is not static, but like the blood and lymph undergoes a process of flux. The migration of cerebrospinal fluid has been called by Cushing⁴ "the third circulation," but its motion is dependent upon factors somewhat different from those which govern the circulation of the first and second circulations, i.e., the circulation of blood and lymph. The motion is secondary to a process of secretion and reabsorption. Inasmuch as the place of reabsorption is distant from the area of secretion a slow migration results.

The cerebrospinal fluid is a modified blood serum secreted, most authorities agree, through the cuboidal cells of the choroid plexus in the lateral ventricles. From these cavities the fluid passes by way of the foramen of Munro into the third ventricle and through the Aqueduct of Sylvius into the fourth ventricle. From the fourth ventricle it escapes by way of the foramina of Luschka and Magendie into the subarachnoid space which surrounds not only the brain but the spinal cord and communicates with the cisternae of the skull and the sulci of the cortex.

The mode of reabsorption of the fluid is still a matter of debate, two theories being fairly widely held; (a) that of Weed,⁵ which maintains that it escapes by a process of filtration through the mesodermal cell membrane of the arachnoid villi into the venous sinuses of the skull, and (b) that of Dandy and Blackfan,⁶ which maintains that it is removed by the stomata in the walls of the supracortical veins of the entire subarachnoid space, particularly by the stomata in those veins situated in the sulci and about the Pacchionian bodies along the longitudinal

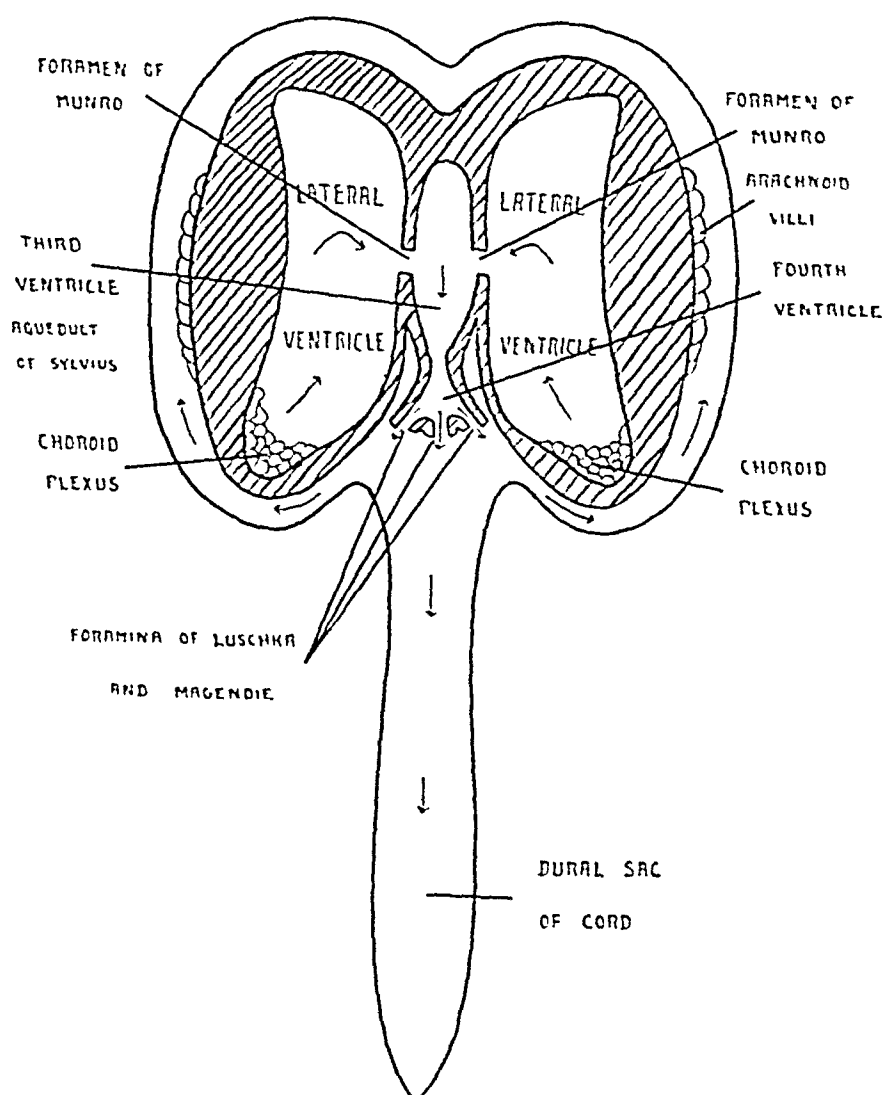


FIG. 10. Partly schematic drawing illustrating the manner of circulation of the cerebrospinal fluid, the "third circulation of Cushing." The cerebrospinal fluid is formed by a process of filtration from the blood plasma in the choroid plexuses of the lateral ventricle. It escapes by way of the foramen of Monro into the third ventricle and thence through the aqueduct of Sylvius into the fourth ventricle. From the fourth ventricle it goes out to the subarachnoid space of the brain and cord by way of the small foramina of Luschka and Magendie. It is absorbed either through the mesodermal cell membrane of the arachnoid villi or through the stomata in the walls of the arachnoid vessels (the lymphatic vessels). Absorption thus occurs on the surface of the brain and spinal cord, the absorption in the spinal cord.

sinus. Accordingly, increases in pressure within the cranium may result either from increased secretion or diminished reabsorption of the cerebrospinal fluid (Figs. 66 and 67).

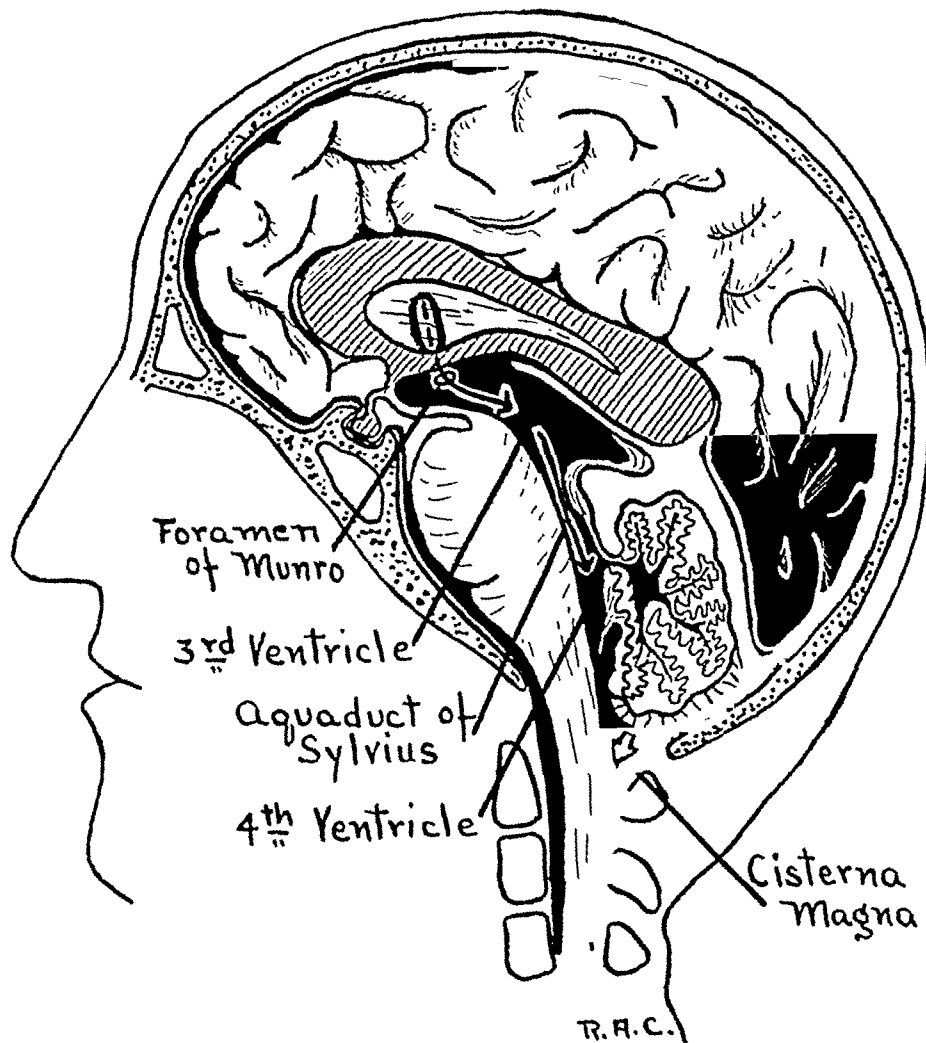


FIG. 67. Partly schematic drawing of a sagittal section of the head showing the essential anatomy of the circulation of the cerebrospinal fluid within the cranium.

The mechanism concerned in the minor degrees of head injury in which no skull fracture is sustained seems to be somewhat as follows:

The skull is slightly flattened by the impact of the injuring object, and this flattening can take place only at the expense of the cubical contents of the skull. This means that some of the contents must undergo displace-

ment into the various openings leading from the skull cavity; during this process the fine fibrillar attachments of the blood vessels are ruptured, and even the blood vessels themselves may be torn.

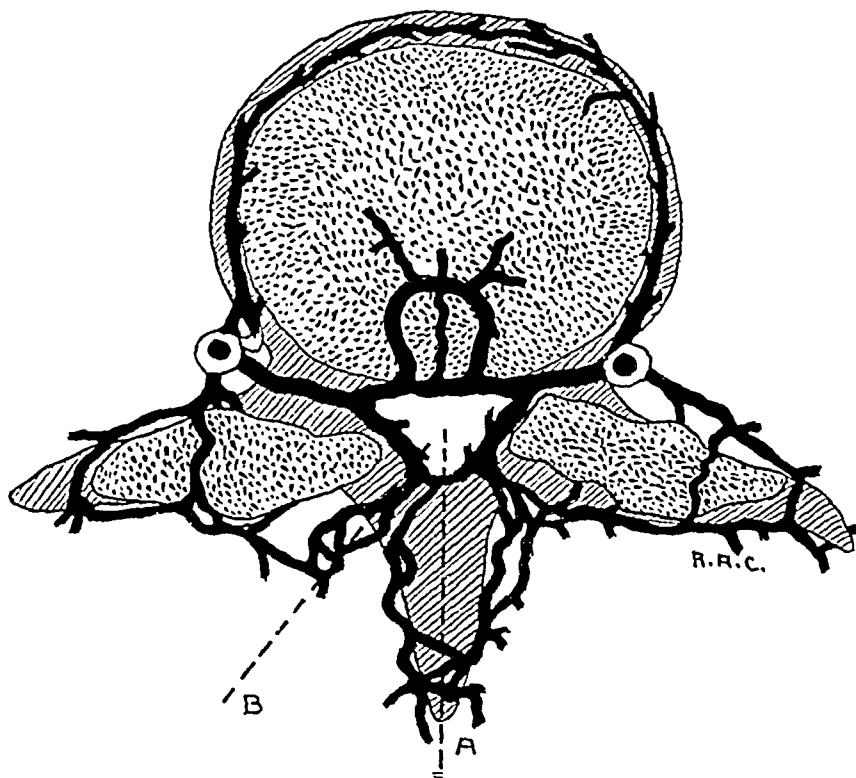


FIG. 68. Partly schematic drawing modified from Pitkin¹ showing in cross-section the anatomical arrangement of the blood supply to the cord. A spinal puncture needle introduced at one side of the midline and passing between laminae as indicated by the dotted line B is much more likely to injure sizeable blood vessels than a needle introduced properly between the spinous processes and strictly in the midline as indicated by the dotted line A.

V. THE INTERPRETATION OF SYMPTOMS ON THE BASIS OF THE PATHOLOGICAL PHYSIOLOGY AS OUTLINED

In the interpretation of symptoms arising from increased intracranial tension it is convenient to classify them according to their source, i.e., whether secondary to pressure upon the cerebral hemispheres, the midbrain, or the bulb, and also

¹ Pitkin, G. P. *J. M. Soc. New Jersey*, 24: 425, 1927.

according to their nature or severity, i.e., whether irritative or paralytic. Early symptoms of compression tend to be *irritative* and may be *localized*, as, for example, those of a subdural hematoma, a depressed fracture, or a punctate intracerebral hemorrhage, or *generalized*, as in the case of cerebral edema. Late symptoms tend to be paralytic and may also be either *localized* or *generalized*.

A. IRRITATIVE LESIONS: 1. *Cortical*: The irritative symptoms in lesions of the cerebral cortex may be either sensory or motor, or both, depending upon the region of the cortex principally involved. Hallucinations of sight, sound, and smell are not infrequent in early lesions of the occipital and anterior temporal regions, but they are not of much diagnostic value, since they are usually very transient, the patient very soon lapsing into a semiconscious condition in which the cooperation indispensable to their proper interpretation is necessarily absent.

Irritative lesions affecting the motor cortex are, on the other hand, of much greater value, because they persist even in the absence of consciousness. Muscular rigidity and spasm, fibrillary twitchings, and, in the more typical cases, true Jacksonian epilepsy, indicate involvement of the motor cortex and the pyramidal system.

2. *Midbrain*: Irritative lesions of the midbrain manifest themselves by pupillary changes, but these changes occur late, unless the primary lesion is in, or very close to, the oculomotor nuclei. Inasmuch as the nuclei of the two sides lie very close together both tend to be simultaneously involved, though not infrequently close observation will show that the symptoms on the side primarily affected develop slightly in advance of those on the opposite side. In irritation the pupil becomes contracted and reacts sluggishly.

3. *Bulbar*: The three centers primarily affected in the bulb are (1) the respiratory, (2) the cardiac, and (3) the vasomotor. Of these the respiratory is most susceptible to the effects of pressure, the vasomotor the least susceptible. Irritation of the

respiratory center produces deep, slow breathing, irritation of the cardiac center produces a slow and full pulse, and irritation of the vasomotor center increase in blood pressure and the Cheyne-Stokes type of respiration.

B. PARALYTIC LESIONS: 1. *Cortical*: Paralytic effects on the sensory cortex consist particularly of the development of unconsciousness; occasionally, however, aphasia, due to involvement of Broca's convolution of the frontal lobe may precede the development of unconsciousness, and somewhat more frequently anesthesia or analgesias of hemiplegic distribution can be elicited even in the presence of developing unconsciousness and can be evaluated by the alert observer as indicating involvement of the corresponding sensory areas of the cortex. Infrequently the development of hemianopsia is a sign which occurs before the loss of consciousness and when present is of great significance. The motor paralyses are of much more importance and consist of hemipareses and hemiplegias, exaggeration of the deep reflexes, loss of abdominal reflexes, and the Babinski and other special signs.

2. *Midbrain*: Paralytic effects on the oculo-motor nuclei produce the dilated and fixed pupil; in the early stage of paralysis the pupil, though fixed, is only slightly dilated, whereas in the later stage it is both fixed and widely dilated.

3. *Bulbar*: Paralytic effects on the respiratory center consist of irregular and shallow breathing, on the cardiac center rapid, small and easily compressible pulse, and on the vasomotor center rapid fall in blood pressure.

VI. THE SPINAL TAP AS A DIRECT MEASURE OF INCREASED INTRACRANIAL TENSION

Considering the effect of displacement of the fluid contents of the cranial cavity as the result of increased intracranial tension, it is but a step to the direct estimation of the amount of such pressure. Although blood, as well as cerebrospinal fluid, is displaced by such increased tension, the blood pressure

exhibits a very complex mechanism of readjustment to local changes of pressure. For this reason the amount of displacement of cerebrospinal fluid is taken as a guide, and this is estimated by determining the amount of rise of pressure in the communicating subdural space of the cord. Direct measurement can be accomplished by introducing a needle or cannula into the subdural space in the lumbar region and reading the pressure as indicated on an attached manometer.

The technique of lumbar puncture for purposes of estimating cerebrospinal fluid pressure is a subject which has not been sufficiently stressed in the past. For obvious reasons, in order that successive estimations be comparable either with respect to the same patient or succeeding patients, a technique must be adopted which can be standardized. Puncture in the sitting position is not feasible in a fairly large percentage of cases, and in any event the impossibility of allowing for the factor of hydrostatic pressure in such a position is enough to condemn the procedure; it is irrational to assume to measure the pressure at the top of a column of fluid by measuring the pressure at the bottom. The only standard position which all patients can assume and which eliminates hydrostatic variations is a recumbent one with the level of the ventricles the same as that of the point of introduction of the needle. With this limitation the position of the patient is a matter of relative indifference except that at least during the process of introduction of the needle he is usually required to flex the back by bringing the knees and chin as near together as possible, thus arching the back and widening the distance between the spinous processes. Whether he be required to lie on one side or the other is largely a matter of convenience.

Skin preparation is made in the lumbar region as if for a major surgical procedure, a relatively large area being sterilized. Scrupulous care is, of course, taken in the handling of sterile needles and syringes used in performing this little operation to avoid infection of the contents of the spinal canal, a circumstance which is, indeed, a calamity. An area is

selected for puncture in the midline just below a line connecting the crests of the ilia and just below the spinous process of the vertebra next above this line. This usually brings the site of puncture between the second and third lumbar vertebrae. The skin is barely pierced with a fine hypodermic needle which is directed inward at an acute angle with the skin surface, and a considerable wheal in, and not under, the skin is raised with 1.0 per cent novocaine solution. Although the subcutaneous tissues are relatively insensitive to pain, and for this reason need not necessarily be infiltrated, the patient may be saved some discomfort if the deeper layers are treated, especially the ligamentum subflavum. For this purpose the needle is now redirected so that it points directly inward in a direction perpendicular to the skin surface, and about 5 c.c. of novocaine solution are thoroughly infiltrated into the tissues as far as the hypodermic needle will reach.

The lumbar puncture proper now proceeds with the introduction of a relatively fine lumbar puncture needle through the skin wheal and in the same direction as the last insertion of the hypodermic needle, i.e., strictly in the midline and strictly perpendicular to the skin (Fig. 68). The size and shape as, well as the mode of introduction of the lumbar puncture needle, are of real importance in the avoidance of complications. Pitkin, who has devised the method of "controllable spinal anesthesia,"⁷ has recently illustrated a type of needle suitable for the purpose which cuts a small trap door in the dura; this trap door closes as soon as the needle has been withdrawn after the puncture, a technique which theoretically at least seems to be capable of preventing continued seepage of cerebrospinal fluid from the puncture wound into the surrounding tissues and thus tends to minimize postpuncture headaches (Fig. 69). Punctures should be made in the midline in order to avoid miscalculations due to angular variations and also to prevent injury to veins; the bevel of the lumbar puncture needle should be short in order to insure the localization of the terminal lumen of the needle entirely within the spinal canal. The depth at

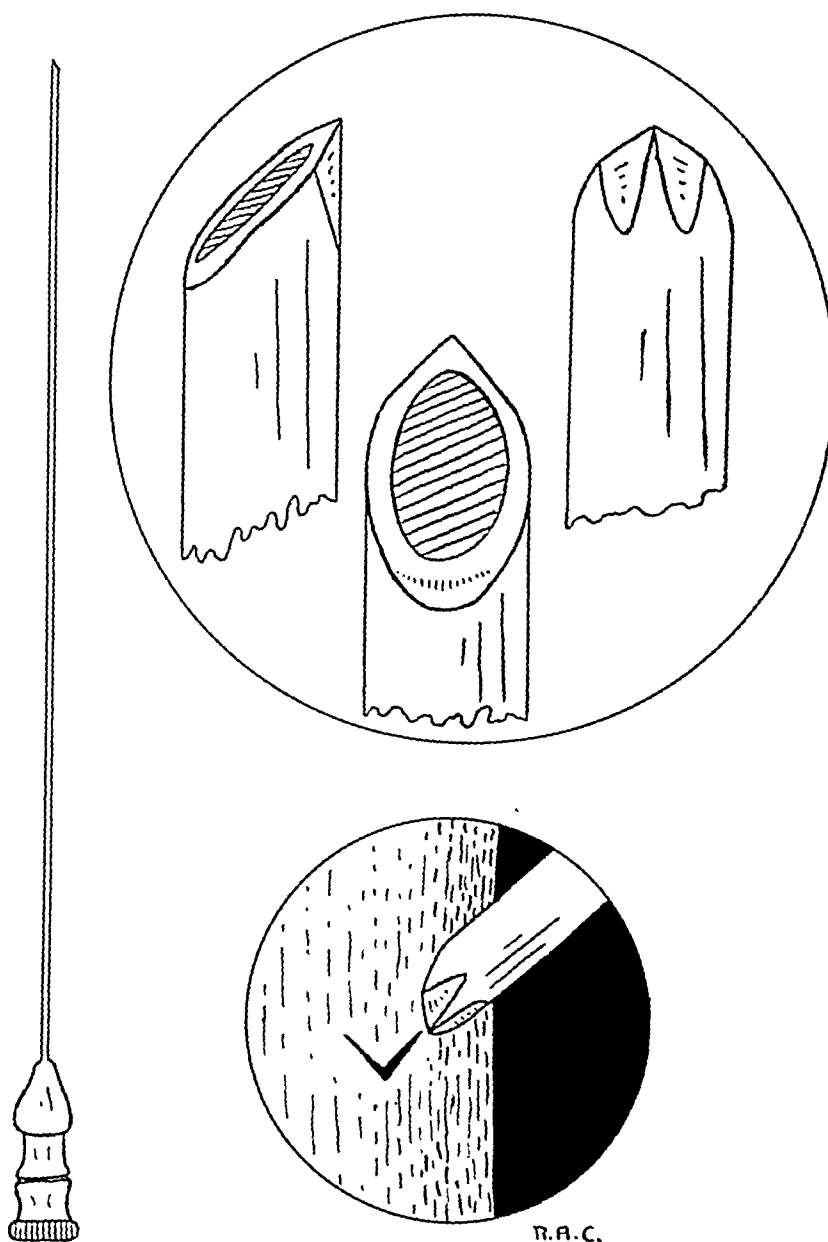
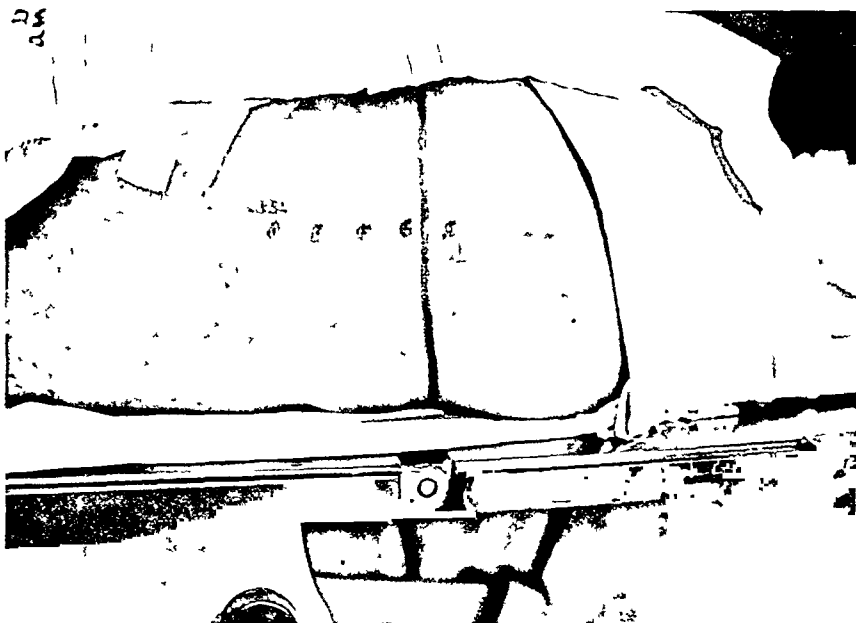


FIG. 69. Mechanical features of a specially ground spinal puncture needle (after Pitkin). On left is shown general proportions of needle; it is made of flexible steel and should be sufficiently ductile to allow bending into complete bow or semicircle. Upper insert shows magnified view of point of needle; note that the point has short primary bevel and that the shape of the point has been modified by three accessory bevels, two edge at base of primary bevel. Lower insert shows shape of trap-door which is cut by such a needle in the dura mater; the "v" shaped flap tends to close and prevent continued seepage of cerebrospinal fluid after withdrawal of needle.

which the dura is reached varies, and it is frequently necessary to redirect the needle slightly one or more times before the canal is finally reached. A distinct feeling of resistance followed



FIGS. 70, 71, and 72. Technique of diagnostic and therapeutic lumbar puncture.

FIG. 70. Patient is lying flat on left side; knees are strongly flexed on abdomen and head and shoulders on torso. Note prominence of sacrum and rhomboid of Michaelis just to right of center of photograph; patient presents secondary rash of lues. Line has been drawn with mercurochrome between two crests of ilia, and spinous processes in lumbar region have been indicated by spots of mercurochrome; line passes ordinarily between third and fourth lumbar spines.

by a sensation of marked decrease of resistance to the progress of the needle usually indicates that the dural sac has been pierced. On withdrawal of the obturator from the needle the exudation of clear or blood-stained cerebrospinal fluid, as the case may be, indicates definitely that the puncture has been successful, and a mercury manometer is immediately attached to the needle, keeping the meniscus of the mercury always on the same level as the spinal canal in order to avoid hydrostatic effects (Figs. 70, 71 and 72).

Mere guesses as to increased or decreased pressure in the absence of accurate manometric readings when performing lumbar puncture are of no value, since the only basis on which

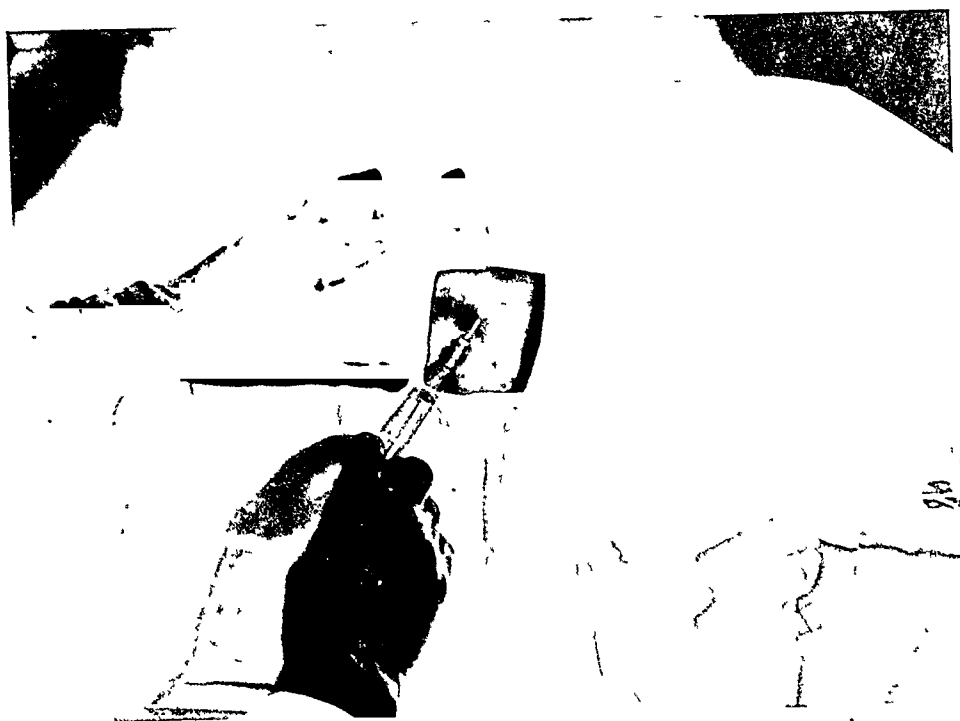


FIG. 71. Point has been selected strictly in midline and just below spinous process of third lumbar vertebra; wheal is being raised in skin by means of a hypodermic syringe, a fine needle and a 1 per cent novocaine solution; note that the patient is thoroughly draped.

guesses of this kind can be made is the rate of flow of fluid from the needle and this depends on other factors besides the factor of pressure, mainly, of course, upon the size of the lumen of the needle.

Readings on the manometer should never be taken as final for several minutes after puncture, or until several observations at intervals indicate that the pressure has become stationary. Sometimes this does not occur for a matter of five minutes, and it is not infrequently necessary to have the patient cough or to have an assistant exert pressure on the external jugular veins to make sure that there is a free flow of fluid into the manometer and that the true pressure is, therefore, being recorded.

The phenomenon of increase in cerebrospinal fluid pressure when the jugular veins are compressed is known as the "Queckenstedt Sign." It depends upon the following cycle of



FIG. 72. Spinal or lumbar puncture needle has been introduced, spinal fluid has been obtained, and a spinal manometer has been attached to lumbar puncture needle. Note manometer is being held on level with needle in order to avoid hydrostatic effects caused by weight of column of cerebrospinal fluid alone.

events, (1) the production of venous stasis in the skull, (2) increase in intracranial pressure due to this stasis, (3) and displacement of cerebrospinal fluid from the skull to the dural sac of the cord; accordingly, the test is of value in demonstrating that there is no blockage in the subarachnoid space between the point of puncture and the skull.

VII. THE TREATMENT PROPER

A. SHOCK: If patients with head injuries are admitted in shock the treatment for shock is invoked at once, the local injury being disregarded except in such cases as require the

control of hemorrhage, the precaution of covering open wounds with sterile dressings being all that is required. The fundamental treatment for shock consists in:

- (a) Lowering the head (or raising the feet) to combat cerebral anemia by the action of gravity on the blood stream,
- (b) Application of heat in the form of hot water bottles to the body, especially to the extremities, to combat subnormal temperature,
- (c) Administration of hot drinks if the patient is in a condition to take them,
- (d) Administration in the severer cases of a proctoclysis of 1000 c.c. of warm tap water (110°F) or an intravenous infusion of 500 c.c. of 5 per cent dextrose solution or physiological saline solution (110°F).
- (e) Transfusion of 500 c.c. of blood in the severest cases, especially those secondary to blood loss, and
- (f) Perhaps most important of all, the hypodermic administration of morphine in relatively large doses, usually half a grain at a time.

The administration of morphine should be guarded, however, lest the effect of the drug be confused with beginning coma, and in those cases in which such confusion cannot be eliminated by blood pressure readings, spinal taps, or otherwise, morphine should, of course, be withheld. Usually in the case of head injury, however, the prognosis and treatment depend not so much upon the development of symptoms as of signs, and even though certain symptoms are masked by the morphine, the signs are usually amply sufficient.

A certain number of patients never react from shock. Such patients do not regain consciousness, present a low blood pressure and rapid pulse, and pass rapidly from a condition of subnormal temperature to one of hyperpyrexia just before death. At autopsy widespread contusions of the brain substance, extensive lacerations, and free hemorrhage are characteristically found.

B. EARLY TREATMENT AFTER RECOVERY FROM SHOCK: After recovery from shock the head of the patient is raised to combat the development of edema; frequently the patient may be set virtually bolt upright in bed. Of how much value the application of an ice-cap to the head may be at this stage in uncomplicated cases there is some question; such a procedure is usually grateful to the patient but probably is otherwise of relatively little value.

Two considerations now present themselves, the one having to do with the local treatment of any scalp wounds which may be present, the other with the special study of the case, particularly the skiagraphic study.

Because of the rich blood supply to the scalp, wounds in this region tend to heal kindly, but wide shaving of the scalp around lacerated wounds, debridement of wound edges, and thorough probing of wounds suspected of concealing depressed or comminuted fractures or foreign bodies should not be omitted. Primary suturing without drainage can usually be performed, especially in cases of brain injuries.

In cases in which there is hemorrhage or leakage of cerebrospinal fluid from the ears, nose, or mouth, probing and douching of these cavities should be avoided; the indications are simply to cleanse the more accessible parts and preserve the cleanliness in as simple a manner as possible.

The taking of from two to half a dozen skiagraphic plates of the skull from different angles and in different positions is of considerable importance, both from the point of view of establishing the diagnosis of such fractures as may require immediate surgical treatment and also for purposes of future reference in connection with legal medicine, workmen's compensation, permanent hospital records, and the development of complications in general.

C. CONDITIONS DEMANDING PRIMARY RADICAL SURGERY: Three conditions demand formal operation as soon as diagnosed after reaction from shock: (1) the presence of foreign bodies within the cranial cavity; (2) the development of middle

meningeal hemorrhage; and (3) the presence of depressed fractures of the vault.

The presence of foreign bodies within the cranial cavity is not well tolerated by the organism. Local infectious processes, i.e., abscesses, are very apt to occur in and about foreign bodies, such as spicules of bone or blood clot which are allowed to remain for any considerable length of time in relation with the leptomeninges. The infectious organisms gain entrance to such a *locus minoris resistentiae* either by direct extension, in connection with compound fractures, or by way of the normal openings of the skull and especially by the blood stream. Traumatic insults that are handled easily by the frontal lobes and which result in no permanent damage may produce a rapidly fatal infection when affecting the basal structures.

Probably the best known complication of head injuries is middle meningeal hemorrhage which is recognized by the development of the typical "meningeal syndrome" as previously described. The treatment of this complication is, of course, immediate surgical intervention for the purpose of evacuating blood clot and tying the ruptured blood vessel. The presence of a depressed fracture constitutes an indication for an operation aimed at the elevation of the depressed fragment.

A sign of possible diagnostic value in localizing the side involved in obscure craniocerebral lesions is the presence of a decrease of temperature in the axilla of the affected side; this may amount to 0.5 or 1.0°.

D. THE NON-SURGICAL TREATMENT OF INCREASED INTRACRANIAL PRESSURE: 1. *The Use of Hypertonic Solutions, Dehydration Therapy*: To Weed and McKibben^{8,9} belongs credit for having first demonstrated that the volume of the brain substance can be *decreased* by the intravenous injection of *hypertonic* salt solutions or *increased* by the injection of *hypotonic* solutions and that corresponding changes occur in the pressure of the cerebrospinal fluid as measured by manometric readings taken by means of spinal puncture. These

authors used distilled water as a hypotonic agent and concentrated sodium chloride, sodium bicarbonate, sodium sulphate and dextrose as hypertonic solutions. They found a marked and sustained increase in the cerebrospinal fluid pressure after the injection of distilled water, whereas, after the injection of the hypertonic solutions there was a transitory initial increase in the pressure of the cerebrospinal fluid followed by an immediate and pronounced decrease. These changes were found independently of the amount of the solution used and were interpreted as fundamentally due to osmotic effects.

The work of these original investigators has been repeated many times and by many different authors, especially in connection with the treatment of clinical cases and accordingly may be said to have been amply substantiated.

Foley and Putnam,¹⁰ in the year following the original reports of the previously named authors, found that the administration of sodium chloride *by mouth* accomplished the same result, and they added the hypothesis based on indirect evidence that both the intravenous and *per os* administration of hypertonic solutions not only decreases the brain bulk but also changes the ratio between the absorption and excretion of cerebrospinal fluid.

Ebaugh and Stevenson¹¹ and Fay¹² have shown that in addition to the initial decrease in cerebrospinal fluid pressure there is a secondary increase or "wave of edema" which occurs following the ingestion of sodium chloride by mouth, which they explain as due to a storage of sodium chloride in the brain tissue, as they did not encounter the phenomenon following the use of dextrose solution. These authors also found that the intravenous injection of 200 c.c. of a 30 per cent dextrose solution is not accompanied by the appearance of glycosuria.

Kinsman, Spurling, and Jelsma¹³ have been able to demonstrate that the decrease in cerebrospinal fluid pressure which ensues upon the injection of hypertonic solutions varies in

degree directly with the concentration and amount of the hypertonic solution injected and that this decrease is accompanied by a pronounced and immediate decrease in the specific gravity of the blood serum.

Apparently, as a result of these investigations and others not specifically mentioned one is in a position to formulate the principles (1) that the injection of hypertonic solutions into the blood stream or the administration of such solutions by mouth produces an increase in the molar concentration of the blood in terms of the substances thus supplied which, in turn, results in the withdrawal of fluid from the tissues; (2) that among the tissues thus affected is the brain substance, the shrinkage of which causes concomitantly a reduction in the cerebrospinal fluid pressure; and (3) that although storage of sodium chloride in the brain tissue occurs when this substance is used as a dehydrating agent and a secondary edema follows as a result of this storage, a similar effect does not occur when dextrose solution is used. Whether the dehydrating action of hypertonic solutions is the only mechanism involved in reducing cerebrospinal fluid pressure, or whether in certain cases there is a disturbance of the secretion and reabsorption of the cerebrospinal fluid itself remains somewhat in doubt.

In the administration of hypertonic solutions by appropriate channels, is seen, therefore, an effective means of decreasing elevated intracranial tension, and the method is clinically of so much value that its invocation is urgently indicated both prophylactically and curatively. In the very mild cases of increased tension or in cases in which such a condition, though not actually present, is anticipated, a satisfactory degree of dehydration may be accomplished by the introduction of hypertonic salt solution into the bowel. Sodium chloride solution is not particularly suitable for this purpose because (1) it is very nauseating when given *per os* (2) it is absorbed from the intestinal lumen against osmotic tension (Heidenhain),¹¹ and (3) it tends toward the production of secondary edema as previously mentioned.

Magnesium sulphate is a much more desirable substance for enteric administration and to be effective when so used should be administered in comparatively large doses, from 2 to 3 oz. of a saturated solution by mouth or stomach tube or 6 or more ounces of a 50 per cent solution per rectum in the form of a retention enema every six hours.

In any attempt at the production of dehydration the rigid restriction of fluid intake is, of course, no less important than that of fluid extraction, since the amount of blood and tissue fluid which remains represents a balance resulting from the interplay between the two processes. This applies naturally both to the dehydration just described and also to the method of intravenous medication previously mentioned and now to be expanded. The latter method is particularly applicable to the case of moderately increased tension already developed and will be found efficacious in the treatment of many or most of such cases.

In the production of dehydration by intravenous sodium chloride therapy relatively concentrated solutions are used (25 to 30 per cent), and such solutions are not without danger, unless given very slowly (not more than 1 c.c. per minute); furthermore, secondary edema is particularly prone to occur subsequently, so that unless normal conditions can be satisfactorily restored in a sufficiently short time the last condition of the patient may actually be worse than the first. Magnesium sulphate is not, of course, suitable for intravenous injection for the purpose under discussion because of its narcotizing and toxic properties when thus employed.

Dextrose solution in concentrated form (50 per cent or more) has been found to have a very satisfactory dehydrating effect and is not open to either of these criticisms. It is, therefore, usually preferred, though relatively larger quantities must be employed (50 c.c., 100 c.c., or even more).

For hypertonic solutions of dextrose the following advantages over similar solutions of inorganic salts, particularly sodium chloride, have been claimed:

- (1) They can be given relatively rapidly without danger.
- (2) They do not favor the development of reactionary edema subsequently.
- (3) They are more prolonged in their effects.
- (4) They serve to provide a source of food energy as a secondary action.

2. *The Therapeutic Spinal Tap:* Dehydration, even by the relatively heroic intravenous methods just mentioned, does not avail in all cases. In combating cases of severer degree, or those in which the previously mentioned methods have failed, one other resort is open to the surgeon before resorting to a decompression operation, viz., relief of pressure by withdrawing cerebrospinal fluid by means of spinal puncture. The therapeutic removal of cerebrospinal fluid is a procedure of the utmost value in the more severe types of increased tension which progress unfavorably in spite of attempts at dehydration.

Jackson,¹⁵ in 1922, advocated the treatment of all cases of head injury, save those of arterial hemorrhage and compound or depressed fracture of the skull, by means of therapeutic lumbar puncture, and was able to report a mortality in a series of 46 cases of less than 25 per cent. Munro¹⁶ reported a series of 2908 cases of head injuries collected from 59 different clinics and treated by various other methods either combined with or exclusive of such puncture with an average mortality of 37.8 per cent, and also reported a comparative series totaling 316 cases, 217 cases of which were treated by various unselected methods with an average mortality of 22 per cent, whereas, 99 cases treated by lumbar puncture alone showed a mortality of 14 per cent.

The therapeutic withdrawal of cerebrospinal fluid is not, however, without danger, since it is possible to remove such an amount as to do away with the normal support to the brain stem, thus allowing the medulla to "jam" in the foramen magnum and produce a fatal compression of the vital centers. In order to avoid such a calamity it is never permissible to

withdraw fluid except under the guidance of carefully determined manometric readings.

When this precaution is taken, however, the procedure is eminently safe, and it is probably true that the dangers of sudden death from spinal tap have been somewhat exaggerated; deaths from this source seem to have been associated in most, if not all, cases with chronic increases of intracranial tension due to slow-growing tumors, and especially associated with such tumors as occur below the tentorium cerebelli. Shoenbeck¹⁷ collected 71 cases of such sudden death in which 67 of the cases showed tumor or other chronic disease of the brain, and Gumprecht¹⁸ collected 17 similar cases all showing the presence of intracranial tumors. Certainly many thousands of consecutive therapeutic lumbar punctures with drainage have been performed without proved deaths from this source.

The range of pressure recorded by lumbar puncture in head injuries is considerable and varies all the way from 100 mm. or more to normal (7 to 10 mm.); usually, of course, the higher readings are found in the more severe cases and those which are likely to result fatally.

In connection with the range of cerebrospinal pressures which may be encountered on spinal tap, the tabulations of McClure and Crawford³ and of Jackson¹⁵ may be cited.

	10-20 Mm. Per Cent	20-30 Mm. Per Cent	Over 30 Mm. Per Cent
McClure and Crawford	44.0	34.0	14.0
Jackson	39.8	10.8	2.0

These authors have enunciated the principle that in the performance of therapeutic lumbar puncture for increased intracranial tension *enough fluid should be withdrawn to reduce the excess of pressure over the normal pressure by one-half*; in other words, if the initial reading on the spinal manometer were 30, enough fluid would be withdrawn to reduce the pressure to 20 or 19 depending upon whether the normal pressure be taken as 8 or 10, and if the initial reading were 20, enough fluid would be withdrawn to reduce it to 15 or 14.

This principle is sound, and is generally adopted, except in cases in which more than 15 to 20 c.c. of fluid would need to be withdrawn. Although 30 or 40 c.c. (even 75 to 100 c.c.) or more have been thus withdrawn with apparent safety, it is better when possible to limit the amount to the lesser quantities and perform the operation more frequently when indicated. In this connection and with regard to the time interval between spinal taps the presence of blood in the cerebrospinal fluid withdrawn or the presence of 16 or more mm. of mercury pressure should be sufficient indication for the performance of a second tap in four hours.

Following the teaching of Cushing⁴ it is customary to regard the presence of blood or a xanthoproteic reaction in the cerebrospinal fluid as an especial indication for the performance of repeated spinal punctures. It is believed that the debris resulting from blood disintegration interferes with the normal reabsorption of cerebrospinal fluid by the Pacchionian bodies. The removal of blood contaminated fluid by spinal puncture tends to prevent "clogging" of the Pacchionian bodies and thereby to obviate pressure increases secondary to diminished absorption.

Besley¹⁹ has sounded a note of warning in connection with repeated therapeutic lumbar punctures in his observation that frequent performance of this operation may lead to stimulation of the secretory mechanism of the cerebrospinal fluid and that thus a vicious circle may become established. However, it is believed that such a development is of relatively infrequent occurrence clinically and that even though it may occur occasionally the usual effect is to break an already established vicious circle.

3. *Indications for a Decompression Operation:* Failing in the control of an unfavorable progression of symptoms and signs by all the methods previously mentioned only one resort remains, the institution of radical surgery consisting of removal of part of the cranial vault and decompression by incision of the dura, a procedure the technique of which does not fall

within the province of the present discussion. It may be mentioned in passing that the burden of clinical evidence seems to indicate that such surgery is usually of value only within the

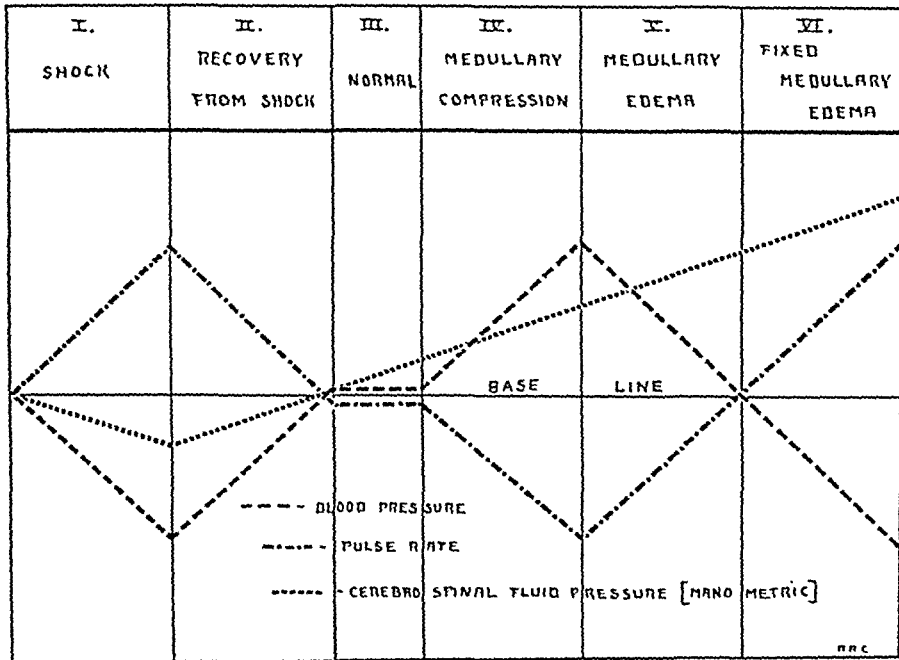


FIG. 73. Graphic chart modified from Gage, showing in craniocerebral traumata typical progression of blood-pressure, pulse rate, and cerebrospinal fluid pressure values according to six stages. Time interval occupied by various stages is variable, one patient passing rapidly from one to another, and another patient much more slowly. Any given patient may present typical progression or may show only a part of it.

first forty-eight hours following craniocerebral injuries and such patients as survive this period of time seem usually either to recover under less radical therapy or to succumb in spite of radical surgery.

E. RÉSUMÉ: As may be gathered from what has previously been said, whereas neurological examinations and a consideration of the developing symptomatology may be of considerable value in the estimation of the severity of head injuries and may serve as a guide to the manner in which a

given case may be progressing, a comprehensive understanding of such cases involves familiarity with the pathological physiology concerned and the estimation of certain variables capable of rather exact determination, pulse rate, blood-pressure, and most important of all, spinal fluid pressure.

The manner of development of these variables in a case exhibiting a typical progression of clinical manifestations has been illustrated by Gage²⁰ in the form of a graph which is reasonably accurate, and which serves as an admirable means of readily visualizing such a typical progression. This chart, with very minor modifications, is herewith reproduced (Fig. 73).

It will be noted that the clinical course of head injuries is divided into six stages: (1) shock, (2) recovery from shock, (3) normalcy, (4) medullary compression, (5) medullary edema, and (6) fixed medullary edema. In the columns headed by the names of these various stages are plotted the characteristic variations of (a) the pulse rate, (b) the blood-pressure, and (c) the cerebrospinal fluid pressure. In the early stages of head injury the recording of pulse rate, respiration rate, temperature, and blood-pressure every fifteen minutes for from four to six hours is of the utmost importance in determining the progress of the patient's condition. Isolated or random estimations of these variables are of but relatively little value, since normal variations are considerable; but when systematically and frequently recorded, a chart of these records gives a very accurate indication of the effectiveness of the treatment instituted and puts the medical attendant in a position to treat the case intelligently and check the development and progression of the complications which may arise. The interval between estimations after four to six hours may be gradually lengthened in cases undergoing a favorable progression of symptoms and signs.

The first stage, or stage of shock, may or may not be present when the patient is first seen; in fact, it may not

constitute a part of the clinical picture at all; it is characterized by increase of pulse rate and decrease of blood-pressure. If present, and if successfully treated by the usual methods, the stage of shock rather rapidly gives way to the stage of recovery from shock, during which stage there is a return of both pulse rate and blood-pressure to normal limits. During the stage of shock the pressure of the cerebrospinal fluid probably decreases in accordance with the depression of the blood-pressure, but inasmuch as spinal punctures are not indicated during the period of shock the exact behavior of the cerebrospinal fluid pressure during this period is of little moment.

The important point is that at the end of the stage of recovery the presence of an increased cerebrospinal fluid pressure indicates that the case is actually progressing unfavorably, whereas the presence of a normal pressure is by no means a guarantee that an unfavorable progression may not even then ensue after a variable period of complete normalcy.

The period represented by *stage three* is really the critical period in a large number of cases; it is of the utmost importance to recognize increased intracranial tension during this period, and the method *par excellence* for doing so is the method of spinal tap.

The period represented by *stage four* is the stage in which active therapy is especially indicated, dehydrative in the borderline and less severe cases, combined dehydrative and spinal decompressive in the cases of greater gravity, and combined dehydrative, spinal decompressive, and cranial decompressive in the severest cases. In cases progressing favorably blood-pressure and pulse rate return to normal, but the same series of events also occurs in those passing into the more advanced stage of medullary edema, so that the only reliable measure of the efficacy of treatment in this stage consists in the measurement of the cerebrospinal fluid pressure which progressively increases in unfavorable cases, decreases in favorable ones.

The stage of medullary edema represents a distinctly serious condition in which the prognosis becomes a matter of grave concern. No method of treatment can be depended upon to curb the progression of symptoms in this stage; dehydration, repeated spinal tap, and cranial decompression may be and, of course, should be tried, but the stage of fixed medullary edema tends to ensue in spite of treatment.

The stage of fixed medullary edema is a terminal affair, and in this stage treatment of any kind whatever is of no avail.

VIII. PROGNOSIS

The prognosis of any but the slightest degrees of head injury should be extremely guarded. Since the incidence of chronic subdural hematoma and gliosis of the cortex has come to be appreciated and a variety of vague major and minor symptoms, accompanied by chronic increases of intracranial pressure, have been described, it has been generally recognized as highly unwise to express in connection with the acute case a very definite opinion as to the eventual outcome of any type of serious head injury. The symptoms of chronic subdural hematoma, arising as they often do from six weeks to six months or more after the original injury, and the symptoms of chronically increased intracranial tension being noted, often for the first time only after several months or even years (Sharpe¹), makes an even comparatively delayed expression of opinion a very hazardous affair. The return of the functions of injured cranial nerves may be very much delayed, and the ultimate outcome is nearly always a matter of very grave doubt.

As to the prognosis in the severe types of injury, as it concerns the life of the patient, only as a result of the very careful weighing of all the evidence can any reasonably accurate estimation be formulated. However, there are certain rather ominous symptom-complexes which may be mentioned and which, if recognized, will immediately indicate to the

medical attendant's mind that the patient's life is in immediate peril:

1. The presence and persistence of dilated or fixed pupils,
2. The early development of the Babinski toe sign,
3. The presence of a persistently bloody cerebrospinal fluid.
4. A steadily rising pulse rate and blood-pressure with increasing restlessness or deepening coma.

Other things being equal, the immediate prognosis in head injuries seems to be somewhat better for children than adults; not only is the percentage of recoveries greater but the percentage of complications less, according to Moorhead and Weller.²¹ Children are, however, more prone to develop late sequelae, such as mental retardation, epilepsy, and spastic paralysis.

Because of the likelihood of the development of untoward complications and sequelae, victims of head injuries are required to remain in bed and under observation in hospitals for much longer periods now than formerly and are advised to report for "follow-up" examinations for a period of at least a year.

The incidence of the late complications of cranial injuries which are found after months or years and consist of persistent headache, mental depression or excitability, change of personality, convulsions, and a host of lesser complaints, has been made the subject of a statistical study especially by Sharpe¹ who attempted to trace the subsequent history of cases of traumatic head injuries discharged from four of the larger hospitals of New York City during the ten-year period from 1900 to 1910. Only 34 per cent of the patients could be traced, but of these 68 per cent complained of symptoms presumably referable to the previous head injury and 50 per cent showed actual objective evidence of increased intracranial tension as shown by manometric cerebrospinal fluid pressure readings.

Although many competent clinicians more or less discredit the etiological relationship between the craniocerebral injury and the development of psychoneurotic manifestations subse-

quently, preferring to incriminate the factor of suggestion rather than any organic lesion, it is probably best to preserve an open mind in the matter until the question has been subjected to more careful investigation. The last word has by no means been spoken at the present time.

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CHAPTER XXIII

THE PREOPERATIVE AND POSTOPERATIVE CARE OF PATIENTS WITH INTESTINAL OBSTRUCTION

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CHAPTER XXIII

THE PREOPERATIVE AND POSTOPERATIVE CARE OF PATIENTS WITH INTESTINAL OBSTRUCTION

I. DEFINITION AND CLASSIFICATION OF ILEUS

Intestinal obstruction, or ileus, may occur either as the primary disease which sends a patient to the surgeon or as a complication in the postoperative convalescence of patients subjected to operations for other reasons, especially in those who have undergone previous laparotomies.

Postoperative ileus is due in almost all cases either directly or indirectly to peritonitis; about one-half of all cases of ileus are postoperative, and the condition of appendicitis accounts for by far the greatest number of cases of postoperative intestinal obstruction.

Cases of postoperative ileus occurring (1) within a few days of an operative procedure are usually directly dependent upon acute peritonitis either localized or generalized, and the obstruction is caused by agglutination, by plastic exudate, of one or more coils of intestine to other coils of intestine, or other intra-abdominal viscera, (2) cases which occur later than this but still within the period of convalescence are usually due to residual abscess formation, and (3) cases which occur after the period of convalescence, occasionally a number of years afterward, are due to strangulation of intestinal viscera by bands of organized adhesions.

Unfortunately for the ease with which the diagnosis of ileus may be made in cases which develop ileus during the period of convalescence from laparotomies the symptoms consist in the early stages merely of abdominal distention, pain, and nausea. Inasmuch as these three symptoms occur to a greater or less extent in most patients convalescing from laparotomies the differential diagnosis between incipient ileus and a number of other postoperative com-

plications like gastric dilatation, dehydration, disturbances of the acid-base balance, and general peritonitis, is usually exceedingly difficult. The diagnosis must be made very largely by a process of exclusion, and frequently the diagnosis can be made with reasonable certainty only after the lapse of a number of hours, and after energetic employment of gastric lavage, hypodermoclysis, and intravenous infusion, and the usual measures for the relief of distension have failed to produce a satisfactory improvement in the patient's condition.

The diagnosis of intestinal obstruction should always be considered and excluded in all cases of appendectomy in which after a period of relatively normal postoperative reaction, nausea and vomiting return, the pulse rate increases and flatus ceases to be passed. Pain may or may not be a prominent feature in cases of postoperative ileus: when severe and colicky the possibility of strangulation should always be considered.

Sir Samson Handley believes that in generalized peritonitis death is never due to the peritonitis itself but always to intestinal obstruction.² He believes that generalized peritonitis always starts in the pelvis and rises in the abdomen like a flood progressively causing peritoneal irritation and paralysis of the loops of intestine as it goes. Death of the patient usually ensues before the advancing process has involved the intestinal coils much above the level of the umbilicus.

Ileus may be defined as an interruption to the flow of intestinal contents through the gut together with perverted motor responses in the intestinal musculature and associated altered metabolic reactions. Ileus is classified into two varieties: (1) the mechanical or dynamic variety, and (2) the paralytic or adynamic variety.

Dynamic ileus occurs whenever there develops some mechanical barrier to the normal flow of intestinal contents through the small or large bowel. Such obstruction of intestinal contents may occur as the result (a) of pressure applied to the intestinal tract from without, as in the case of tumors, misplaced normal organs, or bands of scar tissue and adhesions;

(b) encroachments upon the lumen of the gut, arising from the wall of the intestine itself, usually as the result of tumor formation either benign or malignant; and (c) the presence of foreign bodies within the lumen of the gut, such as, fecaliths, large impacted gallstones, or other foreign bodies. Dynamic ileus may be partial or complete. In its simple form it is accompanied by no decrease in intestinal motility, in fact, the motility of the intestines proximal and even distal to the obstruction is characteristically exaggerated, and the resulting violent movements tend to overcome the barrier to the progress of intestinal contents and so reestablish normal function.

Paralytic ileus may arise under certain circumstances spontaneously and in the absence of any mechanical obstruction to the lumen of the intestines, or it may constitute the secondary or late stage of a preexisting dynamic ileus. It is a condition in which the progress of intestinal contents along the intestinal tract is arrested because of paralysis of intestinal movement; the musculature of the wall of the gut is in a relaxed, atonic, and non-motile condition and there is, therefore, no tendency to overcome a mechanical barrier to the onward progress of intestinal contents if such a barrier be present. The mere presence within the lumen of the intestine of products of digestion which fail to make satisfactory progress toward the anus constitutes a passive condition of simple constipation; ileus, on the other hand, represents the active response of the organism to intestinal stasis.

Murphy and Brooks,³ Hartwell and Hoguet,⁴ Wilkie,⁵ and others have presented evidence to show that the essential factor in the production of ileus is not blockage of the lumen of the intestine, but interference with the blood supply of the intestinal wall; only when such vascular disturbance occurs do the various phenomena characteristic of ileus develop.

An attempt has been made recently by Owings, McIntosh, Stone and Weinberg⁶ to explain interference with the blood supply on the basis of increases in intra-intestinal pressure. Though these particular investigators found the pressure in

various parts of the intestinal tract to be similar regardless of the site of the obstruction and therefore were unable to explain certain characteristic differences between "high" and "low" obstruction, Morton⁷ states that he has been able to demonstrate that the pressure in the duodenum is six or seven times as high in duodenal obstruction as the pressure within the ileum in ileal obstruction. This he believed he could explain on the basis of the fact that more material is secreted into the lumen of the duodenum than is secreted into the ileum (or jejunum) and this he believed would account for the relative severity and suddenness of onset of symptoms in high obstruction; nowhere else in the intestinal tract is so much secretion found as comes from the ampulla of Vater in the form of *biliary and pancreatic secretions*.

Dragstedt, Lang, and Millet⁸ have attempted to incriminate the anatomical topography of the intramural blood supply as of direct etiological significance in the development of ileus. They believe that increases of intra-intestinal pressure are responsible for circulatory embarrassment, but that the degree of embarrassment caused by a given increase in intra-intestinal pressure is dependent upon the relative length of the veins coursing through the intestinal wall; the intramural portion of the veins is longer in the upper intestinal tract and is occluded much more readily than the intramural portion of veins which occur more distally and are shorter. They present good evidence that an intra-intestinal pressure of 35 or 45 mm. of mercury is quite safe within the ileum and colon, whereas within the duodenum and the upper jejunum such a pressure immediately produces venous collapse.

Raine and Perry⁹ have produced additional experimental evidence to show that the essential factor in ileus is embarrassment of the blood supply due to increased intra-intestinal pressure. They found that whereas the administration of water to rabbits in which experimental obstruction had been performed did not appear to influence the course of their condition unfavorably, the administration of liquid alboline

caused a very rapid development of serious symptoms and signs. The explanation offered is that water is absorbed rather readily from the intestinal tract, such absorption keeping the intra-intestinal pressure relatively low, whereas liquid albolene, not being absorbed at all, produces rather prompt increases in intra-intestinal pressure due to its bulk.

It is both clinically and experimentally true that obstruction high in the intestinal tract is very much more speedily followed by the symptoms and signs of disease than intestinal obstruction in the lower portion of the small intestine or in the colon. In fact, it would be essentially true to state that the time of onset and severity of the symptoms of intestinal obstruction vary, the former directly and the latter inversely, with the distance between the pylorus and the site of obstruction. Possibly the foregoing considerations account in whole or in part for this difference in reaction.

II. THE CLINICAL PICTURE IN ILEUS

Patients with obstruction in the small intestine rarely survive for more than six or eight days unless the obstruction is overcome by suitable means, and even then such patients may survive indefinitely or succumb, largely depending upon the duration of the obstruction at the time it is relieved.

Obstruction in the duodenum or uppermost jejunum may prove very much more rapidly fatal, patients usually surviving such obstructions for only two or three days. Obstruction within the large intestine is not inconsistent with life unless prolonged for very much more considerable periods of time, occasionally for several weeks or even two or three months.

The only two invariable signs of intestinal obstruction are constipation and vomiting.

A. CONSTIPATION: Constipation does not, of course, become absolute at the time obstruction occurs; inasmuch as the intestinal canal below the point of obstruction may contain products of digestion and may continue to function normally for a variable period of time the patient may expel

several apparently normal stools; flatus may also be passed as long as the bowel below the point of obstruction still continues to function.

B. VOMITING: Vomiting is the most characteristic sign of obstruction. At first it is accompanied by retching, and the vomited material initially expelled consists of gastric and duodenal contents. Later the vomiting becomes passive and the vomited material may spill out of the mouth without apparent effort on the part of the patient. As the condition progresses and in case the obstruction is low in the intestinal tract, the contents of the jejunum, ileum, and colon are ejected in the order named, and in cases of low obstruction the vomited material may eventually become even fecal in character. Fecal vomiting, however, constitutes no essential factor in the timely diagnosis of obstruction. It is, as has been aptly remarked, a "herald of approaching death."

C. PAIN: Pain may or may not be a prominent symptom, depending upon whether the ileus is obstructive or paralytic in type. In obstructive ileus there is characteristically acute, intermittent, colicky, abdominal pain, similar to that produced by obstruction of any other hollow abdominal viscus. Adynamic or paralytic ileus is characteristically painless in its onset and course.

D. TEMPERATURE, PULSE, AND RESPIRATION: The temperature of a patient suffering from intestinal obstruction is characteristically either normal or subnormal. The pulse, normal at first, becomes progressively weaker and more rapid. Associated with the weak and rapid pulse is an abnormally low blood-pressure. Respirations become progressively more and more shallow.

E. GENERAL APPEARANCE OF PATIENT: In the early stages of ileus the general condition of the patient is comparatively good. In a typical and fully developed case the patient appears acutely ill, his eyes are bright, his cheeks are sunken, and he may present the typical "facies hippocratica." The extremities are cold and clammy, and the hands and feet present fibrillary

twitching. Beads of cold perspiration occur on the forehead; the lips and nail beds are frequently cyanotic. In the terminal stages a deep coma may supervene and this is rather rapidly followed by death. Previous to this time, however, the patient may be unusually alert mentally, and acutely aware of his surroundings. He usually tosses about in bed, may talk of trivialities, and make plans for the future. He rarely recognizes the seriousness of his condition unless specifically warned.

F. LABORATORY EXAMINATIONS: Patients with intestinal obstruction characteristically have a scanty urine, which shows traces of albumin and frequently a few casts. The non-protein nitrogen is characteristically increased from two to seven times the normal amount. Urinary chlorides are proportionately reduced. Kidney function tests, such as the Rowntree-Geraghty test, may show slightly decreased or even normal urinary output. The red blood cell count is normal or somewhat increased. There is characteristically a leucopenia. The blood chemistry findings are characteristic. The blood chlorides are decidedly reduced. There is an increase in non-protein nitrogen which is due almost entirely to an increase in the urea content of the blood. The creatinine may also be increased. The carbon dioxide combining power is characteristically markedly increased.

III. THE DIAGNOSIS OF ILEUS

The diagnosis of intestinal obstruction is made on the basis of the history, the symptoms as previously outlined, and the laboratory findings. The physical examination of patients with intestinal obstruction, except for some inconstant finding such as the presence of an external hernia the contents of which cannot be reduced, is of relatively little consequence. A general discussion of the causes and differential diagnosis of intestinal obstruction need not be here attempted, because such a discussion more properly falls within the scope of general surgical diagnosis. Ileus as a postoperative complication, however, requires especial consideration.



FIG. 74.

FIGS. 74 and 75. Ordinary "flat plates" of patients with early ileus, showing multiple fluid levels surmounted by gas bubbles. These skiagrams were taken with the patients in the upright position, but when patients are too ill to sit upright the same effect may be obtained with the patient lying on the side or the back by directing the x-rays horizontally through the abdomen against a plate held vertically.

Inasmuch as one of the most fruitful causes of postoperative ileus is the presence of angulations and strictures caused by the presence of postoperative adhesions, the diagnosis of ileus



FIG. 75.

should be considered in all cases in which suspicious signs and symptoms occur in patients who have undergone either recent or remote laparotomies. Loops of intestine frequently become adherent to abdominal wounds, and the site of the abdominal

incision may sometimes give a valuable clue to the site of an obstruction. The occurrence of cramps or colicky intra-abdominal pains always indicates that peristalsis is active, and by his sensations the patient is frequently able to localize, with some accuracy, the relative location of the obstruction. It is important to realize that the small intestine is the most frequent site of mechanical obstruction and this is doubtless largely due to the length of its mesentery.

The area of maximal distention in an abdomen, the seat of obstruction, is frequently a valuable indication of the part of the small intestine involved. Obstruction low in the ileum characteristically produces abdominal distention in the lower part of the abdomen; the upper part of the abdomen is relatively flat. Distention in the lower right abdominal quadrant usually indicates that the obstruction is in the low, or terminal portion of the ileum, whereas distention occurring particularly on the left side of the abdomen characteristically indicates obstruction in the jejunum. These considerations apply only to the dynamic type of ileus, for in paralytic ileus distention is characteristically more generalized over the entire abdomen. Obstruction high in the jejunum and obstruction in the duodenum characteristically produce no distention at all.

A type of postoperative ileus seldom considered is that produced by previously existing but unrecognized intestinal carcinoma. Although the ileus produced by a carcinoma of the gut is insidious in its onset in two-thirds of the cases, the other one-third produce symptoms of acute obstruction. The possibility of the occurrence of such an obstruction during the course of postoperative convalescence should not be forgotten, especially in patients past the age of forty years. Crile¹⁰ is authority for the statement that, apart from the development of mechanical obstruction and peritonitis, the occurrence of postoperative ileus bears a direct relationship to the amount of trauma inflicted on the viscera during the course of any operative procedure. It is well to bear this observation in mind when the diagnosis of obstruction comes in question.

In both types of obstruction a diagnostic procedure of the utmost value in cases of doubt consists in the skiagraphic examination of the abdomen of the patient in the upright position. As is well known, the administration of contrast substances to a patient with suspected ileus is a distinctly dangerous procedure because of the possibility of converting a partial obstruction into a complete one as the result of an accumulation of contrast material in the constricted portion of the intestinal lumen.

Such a procedure is unnecessary in cases of obstruction of the small intestine, as first emphasized by Schwarz,¹¹ in 1911, who showed that in cases of ileus the intestine contains both fluid and air, and an ordinary flat plate with the patient in the upright position is capable of showing the presence of multiple fluid levels surmounted by accumulations of gas (Figs. 74 and 75). The procedure is well known in the European clinics, but has rarely been called to the attention of surgeons in the United States, although Case¹² has been partly successful in bringing this procedure to the attention of American surgeons.

In obstruction to the colon there is usually, of course, no contraindication to the administration of a barium enema, and this may occasionally localize the point of obstruction with great accuracy. Roentgenographic examination of the abdomen by one or the other of these methods may be diagnostic within six hours of the onset of ileus and is accordingly one of the most valuable early diagnostic measures which can be employed.

The use of methods designed to stimulate intestinal motility and the elimination of a diagnosis of ileus on the basis of subsequent bowel evacuations is a distinctly dangerous procedure because the lower bowel may evacuate its contents even though an ileus be present in the proximal portion of the gut.

IV. THE PATHOLOGY OF ILEUS

Gross or microscopical changes in the various organs of the body are remarkably absent in patients dying from ileus.

Most of the characteristic changes are found in the intestine itself; the splanchnic area shows extreme vascular engorgement; the intestine above the site of obstruction, if not ruptured, is dilated; the intestinal wall is dusky or bluish-red in color. There may be petechial hemorrhages both beneath the serosa and on the mucosa. The lumen of the intestine is characteristically filled with foul-smelling brown or reddish-brown fluid, and the bacterial content can be shown to be much increased over normal. Microscopically the intestinal wall shows remarkable capillary engorgement and occasional areas of necrosis, especially above the site of obstruction.

Fatty changes in the liver and microscopical evidences of toxic nephritis have been reported, but are not universally found. In experimental animals, Cutting¹³ has found the adrenal glands increased to from three to six times their normal size, and on microscopic examination of the cortex has found multiple areas of focal necrosis with hydropic degeneration of the cells and pycnosis of the nuclear material. In the medulla the chromaffin material was found greatly reduced, and there was an infiltration of lymphoid and plasma cells.

The essential abnormalities found in ileus are considered not to be essentially anatomical, but rather physico-chemical.

V. METABOLIC DISTURBANCES

The physico-chemical changes occurring in ileus together with the symptoms dependent upon such changes have been usually designated collectively as the "toxemia" of intestinal obstruction. The experimental and speculative literature on the "toxemia" of intestinal obstruction has become remarkably prolific within recent years. A review of all of this literature would in itself constitute a rather considerable monograph and could scarcely be undertaken with profit in this connection, as many of the observations which have been made present no clear-cut therapeutic indications in the present state of their development.¹²

Four definite and significant physico-chemical disturbances have been sufficiently demonstrated. All of these changes increase progressively with the development of the ileus, and all of them tend to be more rapid and profound when the obstruction is high in the digestive tube: (A) dehydration, (B) alkalosis, (C) hypochloremia, and (D) increase in the non-protein nitrogen of the blood.

A. **DEHYDRATION:** Hartwell⁴ has apparently shown rather clearly that the dehydration found in ileus is the direct result of vomiting. As Braun and Boruttau¹⁵ have emphasized, the normal intestine produces within twenty-four hours an amount of secretion almost equivalent to the entire amount of blood and lymph contained within the body. The dilated and partially strangulated intestinal wall proximal to the site of obstruction is incapable of reabsorbing the secretions which are poured into the lumen, regurgitation and vomiting occur, and thus is reversed the normal process by which continual and progressive dehydration is prevented.

In the terminal stages the toxemia of ileus produces the characteristic picture of shock; the peripheral capillaries undergo extreme dilatation, and the patient develops profuse cold sweating which still further depletes the body of its water content.

B. **ALKALOSIS:** Hastings, Murray, and Murray¹⁶ were apparently the first to demonstrate that the carbon dioxide combining power of the blood is unusually high in intestinal obstruction. It has been stated that the chlorine ion accounts for 50 per cent of the acid forming elements in the normal blood. The gastric mucosa secretes hydrochloric acid, which, of course, contains chlorine, and the liver and pancreas both secrete quantities of chlorine in the form of sodium and other chlorides. Whether these chloride ions are vomited and thus actually discharged from the body or whether they merely accumulate in the dilated intestine, as in the case of animals like the rabbit which cannot vomit, the effect is the same. If the loss of the acid radical, chlorine, occurs so rapidly and exten-

sively that increases in the acid carbonate radical cannot compensate for them, alkalosis results. MacCallum, Lintz, Vermilye, Legget, and Boas¹⁷ have formulated the idea that the hyperexcitability and tremor frequently shown by patients with excessive vomiting are actually a manifestation of alkalosis, and on this basis have suggested alkalosis as the cause of gastric tetany.

C. HYPOCHLOREMIA: Various explanations have been suggested to account for the hypochloremia of ileus: (1) the fasting usually incident thereto, (2) the concomitant increase in body temperature, (3) the effect of alkali therapy, (4) altered renal threshold, (5) vomiting, and (6) detoxication retention. Most of these factors can be dismissed summarily as unimportant.

In normal individuals the feeding or withholding of chlorides affects the concentration of chlorides in the blood little or not at all. Increases of body temperature do not regularly or extensively lower the renal threshold for chlorides, and in any case fever rarely occurs as a symptom of uncomplicated ileus. Hypochloremia occurs even in those cases in which alkali therapy is not adopted and therefore failure to provide alkali therapy cannot be accepted as explanatory. Haden and Orr¹⁸ do not believe that vomiting accounts for decreases in the chloride content of the blood, because they found consistently that such changes occurred in rabbits and monkeys, both of which animals do not vomit. As suggested by Cooper,¹⁴ however, these observations fail to take into account the considerable quantities of fluid which can accumulate in the dilated portion of the intestine proximal to an obstruction. Haden and Orr¹⁹ have offered the explanation that chlorides are removed from the blood and become fixed within the tissues in combination with toxic bodies. They believe that these toxic bodies are neutralized by this process and become innocuous. Although this explanation has much to recommend it, the administration of chlorides in forms other than sodium chloride is apparently of no value. Furthermore,

Gatch, Trussler, and Ayers²⁰ found on careful examination that the tissue chlorides, as well as the blood chlorides are reduced and in similar proportions.

D. INCREASE OF BLOOD NON-PROTEIN NITROGEN: The blood non-protein nitrogen increase which is observed characteristically in intestinal obstruction is very largely due to increased urea concentration. This phenomenon was first described by Tileston and Comfort²¹ in 1914. It immediately suggests impaired kidney function, but impairment of kidney function is not the cause of the condition, for the increased urea concentration can be shown to be due not to retention but actually to increased formation of urea. Haden and Orr²² and Whipple, Cook, and Stearns²³ have shown that nitrogen excretion in the urine is not diminished in cases of ileus but is actually increased to four or five times the normal value. McQuarrie and Whipple²⁴ have shown that the kidney may be damaged slightly, but that the amount of damage is inconsiderable.

The fact that the kidneys in ileus are capable of secreting so much urea also serves as a very good indication that kidney damage is no essential part of the picture. The finding of excessive amounts of urea in the urine sufficiently disposes of the contention that increases in blood urea are entirely secondary to dehydration and concentration of the blood. Since urea can be derived in no other way than from destruction of proteins or amino-acids, one is forced to conclude that in intestinal obstruction there occurs an exaggerated catabolism of the protein molecule somewhere in the body. Whipple and his co-workers²⁵ explain this on the basis of the action of some toxic body on the tissues, and they believe that the administration of quantities of fluid dilutes the offending toxin and thus produces diminution of protein cleavage. Hartmann and Smyth²⁶ suggest the rather nebulous hypothesis that urea appears in the blood to compensate for the loss of chlorides. They imply that it has some action either in stabilizing the acid-base balance or in maintaining proper osmotic relations.

Bacon, Anslow, and Eppler²⁷ believe that in dehydration the water of hydration is removed from the protein molecule to stabilize the water metabolism; the dehydrated protein molecules then disintegrate with the resultant production of excessive quantities of urea. However, in those cases in which they were able to produce comparable phenomena experimentally by methods other than the production of ileus, there was a marked hyperpyrexia, which, of course, does not occur in obstruction. It must probably be admitted that the explanation of this part of the picture of ileus is as yet obscure.

VI. THE TREATMENT OF ILEUS

A. PROPHYLACTIC TREATMENT: The prophylaxis of ordinary primary ileus is discussed in all textbooks in general surgery and need not be here repeated. The prophylaxis of postoperative ileus, however, may profitably receive brief consideration. Ileus was formerly a much more formidable postoperative complication than it is at present. Many cases developed on the basis of a preexisting localized or generalized peritonitis, and a considerable number of others apparently were directly due to faulty technical manipulations within the abdominal cavity. As the science and art of surgery have been improved the occurrence of postoperative ileus has proportionately decreased. It, therefore, seems obvious that the occurrence of postoperative ileus is favored (1) by delay in the recognition and treatment of disease processes which characteristically eventuate in the development of peritonitis and (2) by inexpertness in technical surgical procedures. Considerations of especial importance in operative technique include: avoidance of undue manipulation of the contents of the abdomen, care in the reperitonealization of denuded areas in an effort to prevent the development of extensive adhesions, careful suturing of the abdominal wall to prevent postoperative herniation and wound rupture, and the more obvious avoidance of the production of any condition which might produce or predispose to

angulation, kinking, or other factors tending to produce mechanical occlusion of the intestinal canal.

Certain patients seem to show a particular tendency to excess connective tissue formation within the abdomen after laparotomy; the plastic exudate which always forms on loops of intestine subjected to trauma, and which in most patients is subsequently liquefied and absorbed, in patients showing this "keloid tendency" undergoes organization and contraction with age. Such patients are especially subject to "postoperative adhesions," and although such a keloid tendency cannot, of course, be recognized at the time of primary laparotomy, it should be considered in connection with secondary laparotomies for the relief of adhesions, and in such cases particular care should be used in order that the last condition of the patient may not be actually worse than the first. Attempts to combat the re-formation of adhesions by the introduction of various substances into the abdominal cavity at the time of operation have usually been relatively unsuccessful. The use of vegetable or animal "digestants" seems to hold some promise of success, papain and possibly trypsin, and also the use of amniotic fluid or some extract from such fluid.

B. ACTIVE TREATMENT: The curative treatment of ileus as at present understood consists of two parts: (1) The reestablishment of normal intestinal flow through the gut, and (2) the treatment of associated metabolic disturbances, i.e., the relief of toxemia. Although these two aspects of the treatment must be discussed separately they are actually both equally important and must be considered in clinical cases not seriatim but in close conjunction.

1. *Reestablishment of Intestinal Flow:* Although no treatment of intestinal obstruction can possibly avail which does not include restitution of the normal flow of intestinal contents toward the anus, the mere reestablishment of the flow may or may not insure the patient's recovery, depending upon the duration and degree of associated toxemia. Clinically, the evacuation of an obstructed loop or segment of intestine,

however accomplished, may either establish the process of recovery or may very soon precipitate the death of the patient. Characteristically, patients who have been relieved of ileus present within a very short time of the restoration of intestinal function an improved appearance which usually marks the beginning of a progressive change for the better, but in certain cases this phase may speedily be followed by a reversal of the clinical picture and the exitus of the patient. Apparently it is possible to precipitate a patient's demise by the sudden restitution of normal activity to an intestine which has been the seat of obstruction for a prolonged period of time. In the treatment of intestinal obstruction, accordingly, promptness in diagnosis and treatment is of the essence of success.

a. *Methods Suitable in Dynamic Ileus:* Dynamic ileus is probably never fatal unless it progresses to the paralytic or adynamic stage, and the treatment of this condition is therefore always surgical. The particular procedure to be performed and the technique of performing it depend to a considerable extent upon the variety of obstruction with which one has to deal. In the performance of any operation on patients with intestinal obstruction, however, a preliminary estimation of the severity of the associated toxemia should be made and if toxemic manifestations are definite, as they will almost invariably be in all cases except those suffering from colonic obstruction of relatively short duration, the rule should be to do only as much surgery as is absolutely necessary and no more. Frequently this will involve little more than the performance of enterostomy; sometimes it may involve the exteriorization of an intestinal tumor which under more favorable conditions would be suitable for formal resection; less frequently, more extensive or more formal procedures are unavoidable, but such manipulations almost invariably put the patient's life in jeopardy. It should be remembered that secondary operation as extensive and technical as may be necessary can always be performed on the patient who lives, but the patient who dies leaves nothing on which to work but his gravestone. Much of the rationale of

the preoperative and postoperative care about to be described in connection with the conduct of cases of adynamic ileus applies with equal force to the case with dynamic ileus, and to this the discussion now proceeds.

b. Methods Suitable in Adynamic Ileus: In those cases in which adynamic ileus is engrafted upon a preexisting dynamic ileus the necessity of the removal of any mechanical obstruction to the onward progress of intestinal contents is, of course, axiomatic. After this has been done, however, and from the onset in primary adynamic ileus the fundamental problem in treatment is the restoration of normal tone and motility to the paralyzed intestinal wall.

The reason for the paralysis of the musculature of the intestine in adynamic ileus is by no means clear, and since the rational treatment of any condition depends upon an understanding of the mechanism by which the condition is produced, the treatment of this variety of paralysis is not as obvious as one could wish. Conceivably the fundamental derangement may involve (1) the individual muscle cells of which the musculature of the intestinal wall is composed, (2) the intrinsic nervous regulating system in the wall of the intestine, particularly the plexuses of Auerbach and Meissner, or (3) the extrinsic nervous system, consisting of the vagus and splanchnic nerves.

Little or no evidence has been presented to show that the fundamental derangement occurs within the wall of the intestine itself. Granting, however, that the fundamental derangement in paralytic ileus consists in interference with the blood supply, it is conceivable that local tissue anoxemia, and degenerative changes incidental to vascular insufficiency may play an essential part in the etiology of the condition. If this is so, it would be rational to attempt by some means to reestablish the normal blood supply. Assuming, furthermore, that the fundamental derangement is one of increased intra-intestinal pressure, the fundamental indication would, therefore, be for the evacuation of the intestinal contents, which

may be achieved to some extent, at least, by the performance of one or more enterostomies.

The Rationale of Enterostomy: It must be admitted, of course, that this is not the view of the function of enterostomy most commonly held. Most of those who have written on the subject assume that drainage of toxic material rather than relief of intra-intestinal pressure is the important function of enterostomy, and doubtless this toxic drainage is quite as important as the relief of vascular stasis due to intra-intestinal pressure. In either case, however, the muscle cell profits directly by the procedure of enterostomy.

Enterostomy is a formal operative procedure and one which, though of minor rank in a normal individual, may assume major proportions because of associated toxemia in a patient with adynamic ileus. Undoubtedly certain patients with frank adynamic ileus develop spontaneous intestinal movement under suitable accessory therapy and recover without enterostomy; consequently, the question of whether to enterostomize, and if so when, often gives cause for considerable anxiety. On such a subject it is dangerous to dogmatise, but, according to Lahey²⁵ in postoperative cases in which a non-mechanical obstruction is diagnosed with reasonable certainty, non-operative measures may usually be employed for about four days with safety. Those obstructions which do not manifest themselves as mechanical will often, according to the teachings of this author,²⁵ be subsequently found to have been resultant upon local inflammatory processes which eventuate in localized intraperitoneal abscess formation. To attempt to drain such an inflammatory accumulation early, especially when such a condition is diagnosed merely on suspicion, is distinctly dangerous. Delay until the process has walled itself off and a definite mass becomes palpable is usually entirely safe and the treatment of such a walled-off process, e.g., in the cul-de-sac of Douglas, is thoroughly satisfactory.

The preoperative and postoperative care of the patient about to undergo enterostomy is of importance. In any case,

but especially if the ileus is associated with peritonitis, especial care should be taken to withhold all food and fluid by mouth, and the administration of cathartic drugs should be carefully avoided. Preoperative gastric lavage is of particular importance and should be performed routinely, especially immediately preceding operative manipulations. Lavage performs the function of removing any toxic material which may have found its way by a process of reverse peristalsis into the stomach; it also relieves the stomach and upper part of the intestinal tract of the pressure incident to the presence of this material and by the relief of distention places this portion of the alimentary canal in a favorable condition for the reestablishment of normal intestinal movement. Lavage also tends to prevent regurgitation of stomach contents into the pharynx and mouth during the course of the operative procedure, and inasmuch as this material may be aspirated as the result of such an occurrence, tends to prevent the subsequent development of aspiration pneumonia. For this reason it is also well to leave the stomach tube in place following preoperative gastric lavage so as to provide easy drainage while the patient is on the operating table.

Because of the fact that patients suffering from adynamic ileus are often intensely ill, the selection of a suitable anesthetic agent is a matter of considerable importance. Ordinarily inhalation anesthetics are generally contraindicated not only because of the danger of subsequent aspiration pneumonia, but because of the diminished vital capacity of the lungs which is secondary to abdominal distention, associated elevation of the diaphragm, and consequent compression of the contents of the thorax. Ordinary local analgesia is the method of choice in some cases, but spinal analgesia and especially splanchnic analgesia have much to recommend them inasmuch as both of these methods have a tendency to restore normal motility to the intestinal tube; the mechanism involved will be discussed presently.

Once the abdominal cavity has been invaded, the required operative procedures should be performed with as little

manipulation and as gently as possible. The fundamental object to be achieved is the relief of ileus and preservation of the patient's life. Cosmetic results are of secondary importance, and although secondary operation may be invoked for the subsequent closure of intestinal fistulae, provided that the patient lives, the patient who dies after the performance of a technically brilliant operative procedure is no better off for all the surgeon's skill. Enterostomy in order to be effective must, of course, be performed in such a part of the intestinal tract as to facilitate drainage of intestinal contents from the obstructed area.

Cecostomy is presumably of very little value for this purpose in most cases, because (1) in the primary paralytic variety of ileus there is only local drainage of toxic products, there being no peristalsis to clear the proximal coils, and (2) in the paralytic ileus engrafted upon the obstructive variety the obstruction is usually higher in the small intestine. An enterostomy through an incision in the left hypochondrium into the upper jejunum by the method of Witzel, bringing the enterostomy tube out through a small rent in the omentum after the method of Mayo, has much to recommend it, since by this means the gut is usually drained proximal to a mechanical obstruction if such be the variety, and if the ileus be primarily adynamic the upper portion of the jejunum contains the most virulent toxic material and is in this variety the logical place to perform drainage.

Jejunostomy was advocated for this purpose by Heidenhain as early as 1897,²⁹ Lennander³⁰ and Lee and Downs,³¹ proceeding on the assumption that toxic products were primarily absorbed from the upper part of the intestinal tract regardless of the site of obstruction, have recently emphasized the value of the method. Haden and Orr,³² however, found experimentally that, if high intestinal obstruction and jejunostomy were performed in experimental animals both at the same time, the period of survival of these animals was considerably shorter than as though no jejunostomy had been performed at all.

They³³ found, however, that when animals with simple enterostomy received quantities of 1 per cent sodium chloride solution hypodermically the period of survival was much increased, and as the administration of a 1 per cent sodium chloride solution is a relatively simple matter they state that "when any doubt exists concerning the value of enterostomy, it should be performed." Van Beuren,³⁴ studying the cases of acute ileus submitted to operation in the Presbyterian Hospital in New York during the past twelve years, found a progressive reduction of the mortality rate in the more recent years, which he attributes, first, to the increasing prevalence of early diagnosis, and second, to the use of early enterostomy. He believes that enterostomy performed properly and at the proper time is a procedure of the greatest value. In case it is decided to delay enterostomy, or postoperatively in cases which have received this form of treatment, restoration of motility is still a desideratum.

Drug Therapy in Ileus: The second possible line of attack upon the motor function of the tissue cells of the intestinal musculature consists of stimulation by drugs, the function of which may be either to increase the irritability of the muscle cell or to decrease the threshold for normal stimuli conveyed to the cell by the nervous regulatory system. Among the drugs which have been used for this purpose are eserine, pituitrin, pitocin, choline, acetyl choline, and peristaltin. The relative inefficiency of all of these drugs has previously been discussed in connection with the relief of intestinal distention and gas pains. As Ochsner, Gage, and Cutting³⁵ have shown, all of these drugs produce a more profound effect on intestines which previously have undergone experimental obstruction than in the normal intestine. However, with the single exception of eserine, none of these therapeutic agents seem to be sufficiently active to be of any particular value in the restitution of normal motility or any degree of motility approaching normal to a gut the seat of ileus, and the drug therapy of paralytic ileus would, therefore, seem to rest on a very precarious basis.

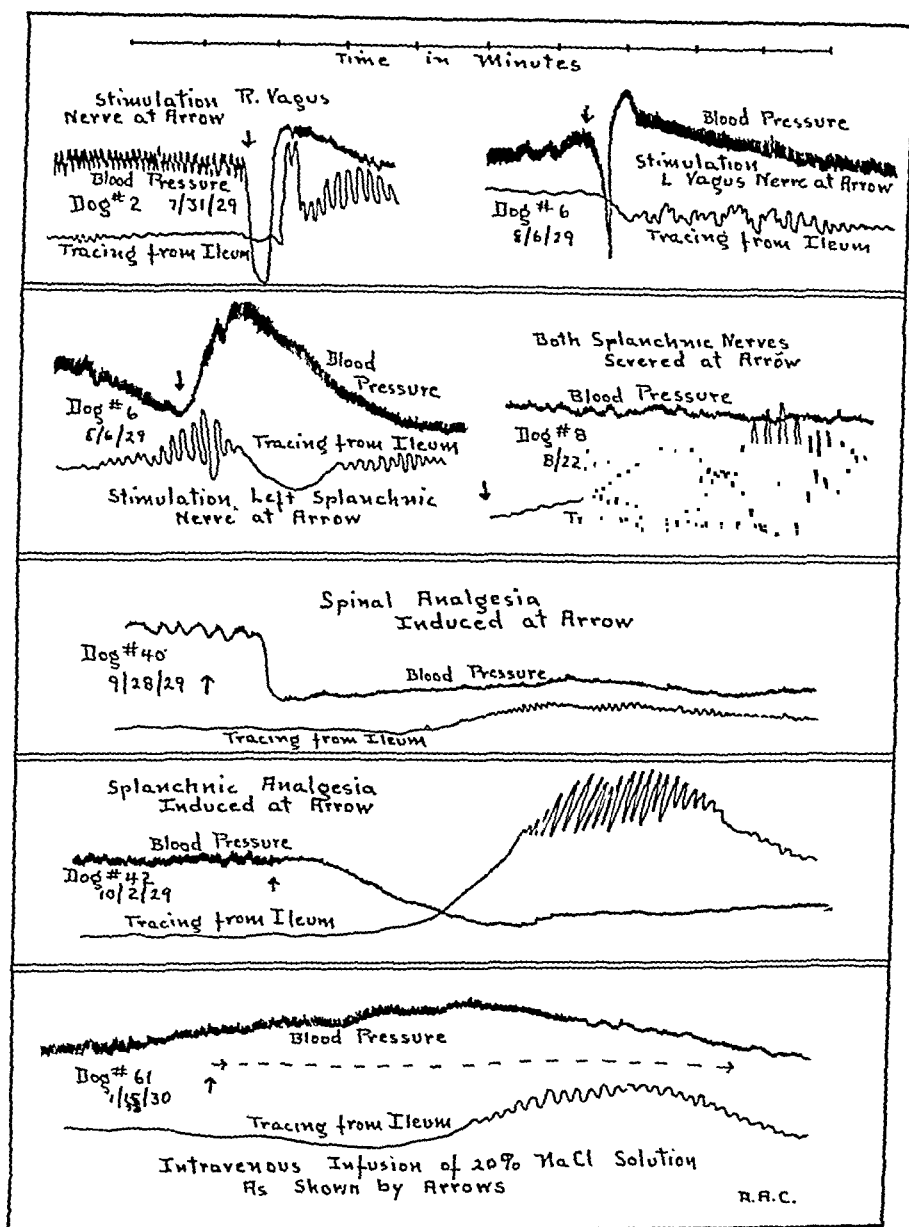


FIG. 76. (Cf. Fig. 37.) Reproduction (greatly reduced) of kymograph tracings showing effect of splanchnic and spinal analgesia and of 20 per cent sodium chloride solution infusions on motor activity of small intestine. At top of figure is a time-marker tracing indicating minutes. With this all of the tracings subsequently reproduced can be compared, since all tracings have been reduced to scale.

Recently various investigators have reported favorably on the use of hypertonic sodium chloride solutions for their effect on intestinal motility. Hughson and Scarff³⁶ found that intravenous administration of hypertonic sodium chloride solution produced violent peristalsis in animals. This observation was also corroborated by Ross.³⁷ Ochsner, Gage, and Cutting³⁵ have found that the administration of a 20 per cent sodium chloride solution is rather effective in producing increases of tone and also increasing the amplitude of intestinal movements. If sodium chloride can be shown to be an efficient intestinal stimulant, it can be made to serve a double purpose, since in ileus the blood chlorides are characteristically decreased and the administration of hypertonic sodium chloride solution would therefore not only increase tone and intestinal movement, but would also be of value in restoring a normal chloride concentration in the blood.

Splanchnic and Spinal Analgesia: Because of the inefficacy of drug therapy designed to stimulate the individual muscle cells or the neuromuscular mechanism within the wall of the intestine, various attempts have been made to attack the problem from the point of view of the extrinsic regulatory nervous system. On the basis of considerable experimental evi-

In upper transverse panel are two short tracings indicating effect of vagus nerve stimulation. Note immediate decrease in blood pressure and subsequent stimulation of intestinal motor activity in both cases.

In next transverse panel are two short tracings showing influence of splanchnic nerves on motor activity of intestine. Note cessation of motor activity which follows stimulation of left splanchnic nerve in first tracing and marked stimulatory effect which follows section of two splanchnic nerves in second tracing.

The remaining three transverse panels represent respectively effects of spinal analgesia, splanchnic analgesia, and intravenous infusion of 20 per cent sodium chloride solution. Note depressing action on blood pressure in all cases; note, however, that in the case of spinal analgesia blood-pressure effect is both immediate and profound, whereas in the case of splanchnic analgesia the decrease is gradual and less in degree. Note increase in intestinal tone shown in all cases, and also increase in intestinal motility, which follows after a short latent period. Note that the effect of splanchnic analgesia on intestinal tone and motility is much more profound than that of spinal analgesia, and that the effect of intravenous infusion of 20 per cent sodium chloride solution is intermediate in efficiency.

dence it is generally accepted that the small intestine, at least, is controlled by a dual and antagonistic nerve supply. Nerve fibers going to the gut by way of the vagus nerves are essentially motor or stimulating in their action. The nerve fibers, however, derived from the parasympathetic system and passing to the intestine by way of the splanchnic nerves are inhibitory in their action. This can be demonstrated easily in the intact animal by stimulating the vagus nerve, whereupon intestinal tone and motility are both decreased; by stimulating the splanchnic nerve intestinal tonus and motility are both considerably increased. Conversely, the cutting of the vagi leaves the splanchnic nerves in complete control and the total effect is one of decreased tone and motility, whereas section of the splanchnic nerves leaves the vagus in full control and the resultant effect is an increase in tone and motility. Considering the extrinsic nerve supply of the intestine as of fundamental importance in the development of paralytic ileus, Domenech and others³⁸ have assumed that in paralytic ileus there is an irritative effect on the splanchnic nerves. The source of this irritative effect in ileus secondary to peritonitis is not far to seek, since it is easy to understand how an inflammatory process of the peritoneum could give rise to reflex splanchnic irritation. It is on this theory, viz., that paralytic ileus is essentially due to splanchnic irritation whether secondary to peritonitis or to some other source of irritation, that the procedures of spinal analgesia and splanchnic analgesia are based. In spinal analgesia the splanchnic fibers are anesthetized at their source as they make their exit from the anterior horn of the various spinal cord segments. In splanchnic analgesia the reflex arc is interrupted after the splanchnic nerves have become fully formed and as they enter into the formation of the greater, lesser, and least splanchnic plexuses in the retroperitoneal space in front of the bodies of the last thoracic and first lumbar vertebrae.

Theoretically, spinal analgesia and splanchnic analgesia should be equally efficient in relieving adynamic ileus, as both

procedures produce a chemical section of the splanchnic nerves. Clinically, spinal analgesia has been used more frequently for this purpose than splanchnic analgesia. Wagner,³⁹ in 1922, gave the first report of the use of spinal analgesia for the relief of ileus. Since this time numerous observations have been made on the use of the procedure, especially by the French school (Asceriades, Mauclaire, Lapointe, Van Lande, Bosse, and Okinczye, Picot, Guibal and others). Duval,⁴⁰ in 1927, was able to collect from the literature 400 cases of acute ileus in which spinal analgesia had been used. Markowitz and Campbell⁴¹ have successfully employed spinal analgesia in treating experimentally produced ileus in dogs. Splanchnic analgesia was suggested by Ochsner, Gage, and Cutting⁴² as a preferable method of producing a similar effect, and recently they have presented evidence to show that, as least in experimental animals, splanchnic analgesia is actually more efficient. Rosenstein and Köhler,⁴³ recognizing the efficiency of splanchnic analgesia, have advocated the use of nicotine by injection into the splanchnic area. They believe that nicotine should be more efficient than novocaine because nicotine has a specific action on sympathetic ganglia. In their experimental investigations they injected nicotine solution directly into the semilunar ganglia and believed that they accomplished by this method a more complete chemical section of the splanchnic nerves than could be achieved by ordinary novocaine solution. The injection of any solution, however, directly into the semilunar ganglia in the human being is quite impossible, the methods available for the induction of splanchnic analgesia being hardly equal to such an accurate localization of drugs. Furthermore, Ochsner, Gage, and Cutting found that nicotine solutions injected in the ordinary way not only produced much less adequate effects than were produced by novocaine solution, but that the blood pressure of experimental animals was reduced to a dangerous degree by the nicotine.

The explanation offered for the superiority of splanchnic over spinal analgesia is that the reflex arc concerned in the

production of ileus is entirely within the splanchnic system. Splanchnic analgesia interrupts this arc in its entirety, presumably producing both sensory and motor effects. Spinal analgesia, on the other hand, interrupts only such portions of the arc as pursue a course within the spinal cord.

More clinical data than at present available must be collected before either the relative or absolute value of these methods can be definitely established. In using splanchnic or spinal analgesia it is essential to realize that success can be expected only in cases in which the intestinal lumen is patent and only in case the therapy is invoked relatively early. The methods are intended not to supplant but to reinforce the treatment of associated toxemia and, inasmuch as neither of these methods seems to affect the large intestine, such treatment should always be supplemented by the insertion of a rectal tube and the administration of an enema. Splanchnic and spinal analgesia when used for the purpose under discussion are performed, of course, not prior to, but subsequent to the performance of enterostomy. A point of particular interest made by Ochsner, Gage, and Cutting⁴² is that the effect of splanchnic and spinal analgesia can be absolutely overcome either by epinephrin or ephedrine. Consequently neither of these drugs should be used in conjunction with either method when used for the relief of ileus. Furthermore, since the action of both spinal and splanchnic analgesia is rather fleeting, no hesitation should be felt in repeating either procedure as many times as may be deemed desirable at intervals of an hour or so.

C. THE TREATMENT OF THE TOXEMIA OF ILEUS: Unfortunately, the treatment of the toxemia of ileus is almost entirely symptomatic. Undoubtedly a clearer understanding of the source and method of production of the toxemia would simplify the treatment considerably, but until such an understanding is gained the best that can be done is to attempt to combat the manifestations of perverted metabolism insofar as they are known.

1. *The Use of Water, Sodium Chloride, and Dextrose:* The dehydration and hypochloremia of intestinal obstruction are conveniently treated together. The obvious treatment is the administration of quantities of sodium chloride solution. Inasmuch as the administration of anything by mouth is strictly contraindicated in ileus, fluids must be administered either rectally, subcutaneously, or intravenously. Ileus, constituting as it does a grave condition and the need for fluid and sodium chloride being acute, either the subcutaneous or the intravenous route is almost universally adopted. Orr and Haden³³ recommend the intravenous administration of 500 c.c. of a 5 per cent sodium chloride solution intravenously in all cases subjected to operative procedures. Eliason⁴⁴ recommends a 5 per cent glucose solution in normal salt solution, McVicar and Weir⁴⁵ a 10 per cent glucose solution in 1 per cent sodium chloride solution.

The addition of hypertonic dextrose solution to solutions for intravenous administration is recommended because of the effect on diuresis. As has been previously mentioned, patients suffering from ileus characteristically show the phenomenon of nitrogen retention. Promotion of diuresis is, therefore, presumably of value in removing the excess of nitrogenous waste products from the blood stream. Postoperatively, and indeed at all times, patients with ileus should be subjected to blood chemistry examinations at frequent intervals, at least twice daily, to determine the efficiency of the treatment.

Careful hemoglobin estimations should be performed to determine whether or not blood concentration is being sufficiently combated. Plasma chloride determinations should be made to determine the presence or absence of hypochloremia; non-protein nitrogen determinations to determine the presence or absence of nitrogen retention, and estimations of the carbon dioxide combining power of the plasma to determine the status of the acid-base balance. It would be futile to attempt to state either the amount of fluid or the composition of fluid suitable for all cases. Most cases require at least from 3 to 5 l.

of fluid per twenty-four hours. All patients need sodium chloride either in normal or hypertonic solution, and probably most patients need dextrose in from 5 to 10 per cent solution. The requirements of individual patients with regard to these substances, however, vary, and it is only by the aid of accurate and frequent laboratory findings that the proper amount of the substances can be determined with accuracy.

2. *The Use of Gastric Lavage and External Heat:* Gastric lavage has been mentioned as a valuable preoperative procedure, but frequent lavage of the stomach postoperatively is almost equally important both in the relief of toxemia and in the promotion of the patient's comfort. Another measure of great value in promoting the patient's comfort, and possibly in the actual treatment of the condition, is the application of heat to the abdomen. Muller⁴⁶ has ventured the hypothesis that in paralytic ileus the decrease of movement in the intestinal tract is associated inseparably with increase in secretion. He believes that the application of heat to the abdomen produces a dilatation of peripheral vessels of the abdomen which is associated with a contraction of the splanchnic vessels by a mechanism of visceral splanchnic balance. The contraction of the splanchnic vessels not only diminishes intestinal secretion, but also increases intestinal motility.

3. *The Use of Perfringens Antitoxin:* A number of attempts have been made in recent years to incriminate the *Bacillus welchii* group of organisms in the production of the toxemia of intestinal obstruction. Williams,⁴⁷ in 1926, fostered this theory. He found that *Bacillus welchii* grew best in a slightly acid or neutral medium, and considered that such a medium was found in the upper, rather than in the lower, portion of the intestinal tract. He made use of immune serum in the clinical treatment of certain cases and reported favorable results. Experimentally, Stabins and Kennedy,⁴⁸ McIver, White, and Lawson⁴⁹ found that whereas the *Bacillus welchii* was present in small numbers in the normal intestinal canal, they increased very remarkably in the presence of intestinal obstruction.

Bower and Clark,⁵⁰ Morton and Scabins,⁵¹ following the lead of the previously named authors, have reported favorable results with antitoxin, the former in clinical and the latter in experimental cases. Oughterson and Powers,⁵² and Owings and McIntosh⁵³ have, however, been unable to confirm these findings, the former making use of antitoxin and serum obtained by the active immunization of animals against the Welch bacillus, the latter authors employing the bacillus *perfringens* antitoxin.

VII. PROGNOSIS IN ILEUS

The prognosis of a well-established case of intestinal obstruction is invariably grave. When associated with peritonitis, the prognosis is even more grave. Of chief prognostic importance is the time elapsing between the onset of the obstruction and the performance of operative procedures. Van Beuren⁵⁴ has stated this succinctly in his aphorism that the longer a patient with intestinal obstruction lives prior to operation, the sooner he dies afterwards.

Miller⁵⁵ states the same truth in a slightly different manner by affirming that as a general rule the mortality rises approximately 1 per cent for each hour of delay in the relief of obstruction. Miller, reviewing a series of 343 cases, found that the mortality rate when the patient was subjected to operative procedures within twelve hours of the onset of symptoms was only 29.4 per cent. Within twenty-four hours this percentage had increased to 42.9 per cent; within thirty-six hours to 50 per cent; within forty-eight hours to 59.6 per cent; within seventy-two hours to 63.4 per cent; within ninety-six hours to 72.8 per cent, and in cases which had persisted for more than ninety-six hours an 84 per cent mortality was observed.

Brill,⁵⁶ in a series of 83 cases, found that the mortality rate was nil when patients were subjected to operation within twelve hours of the onset of symptoms. When such operations were performed in periods between twelve and twenty-four

hours, there was a 12.5 per cent mortality, and between twenty-four and forty-eight hours a 61.1 per cent mortality.

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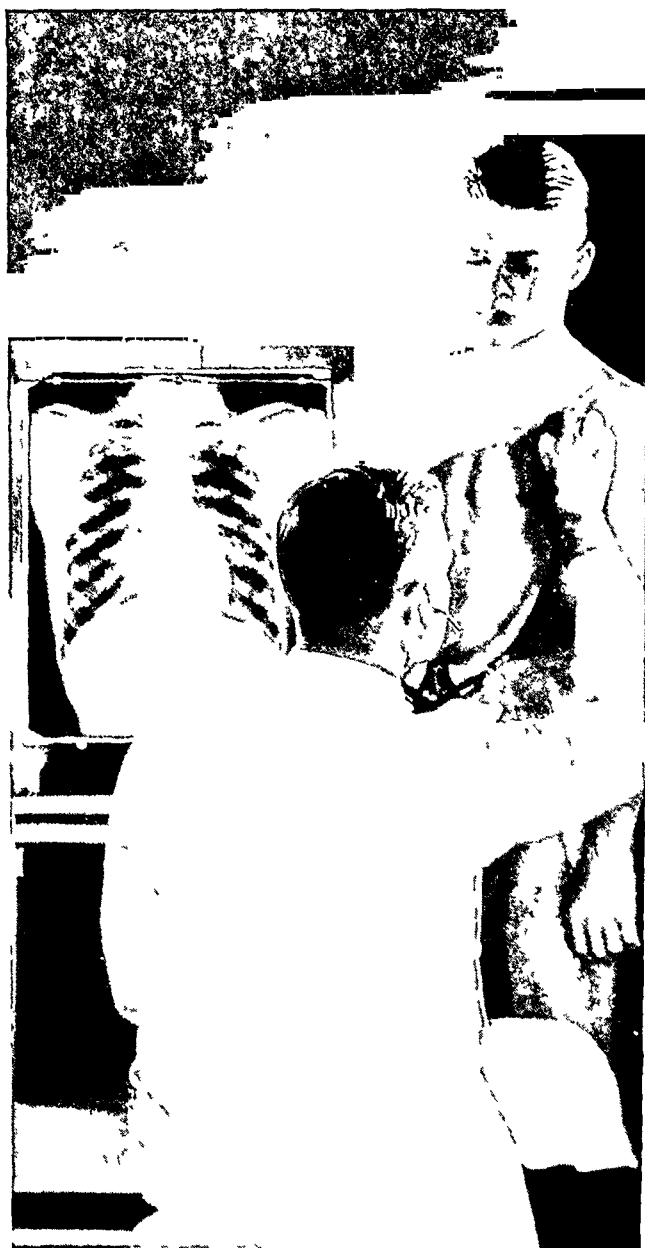
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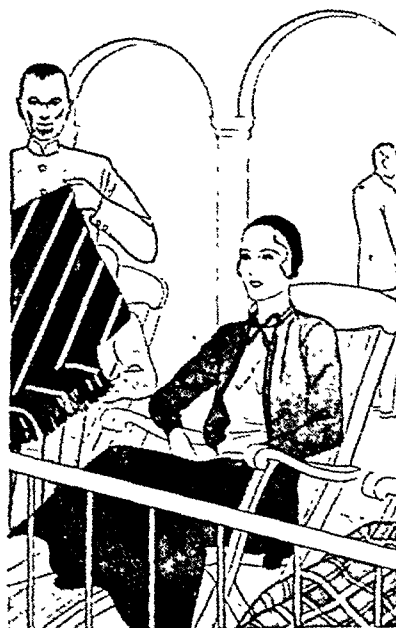
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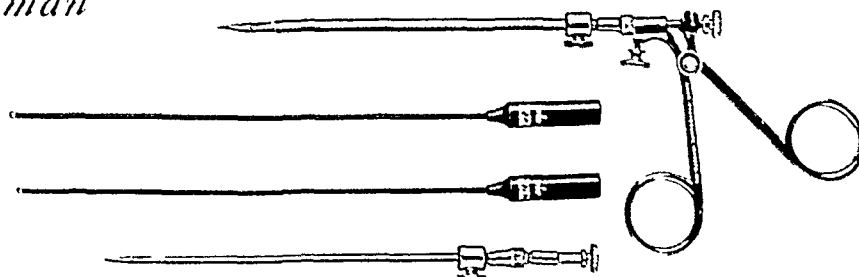
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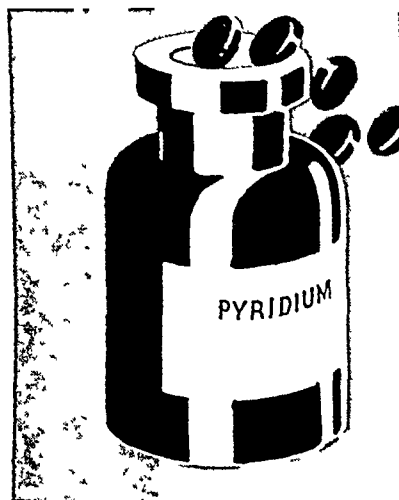
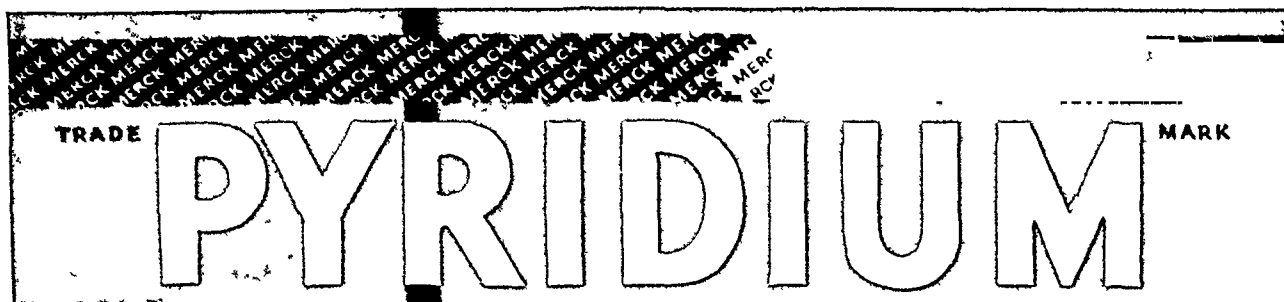
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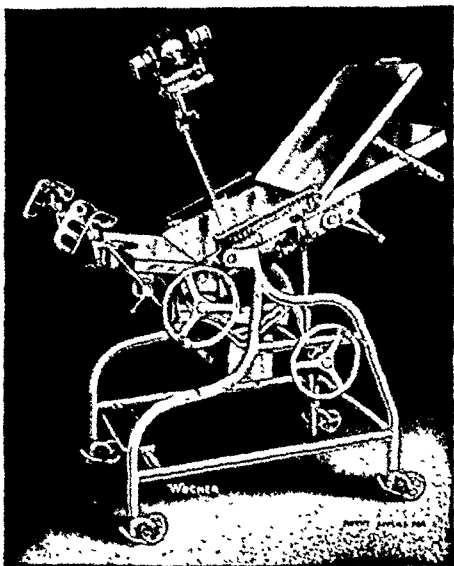
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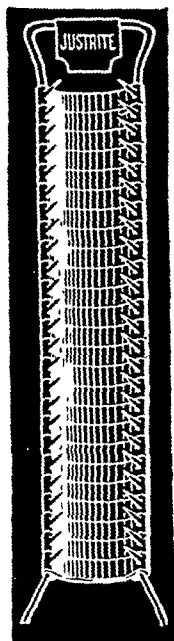
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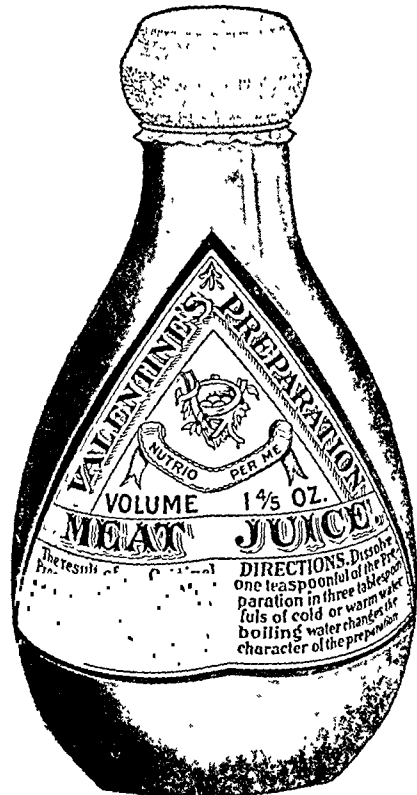
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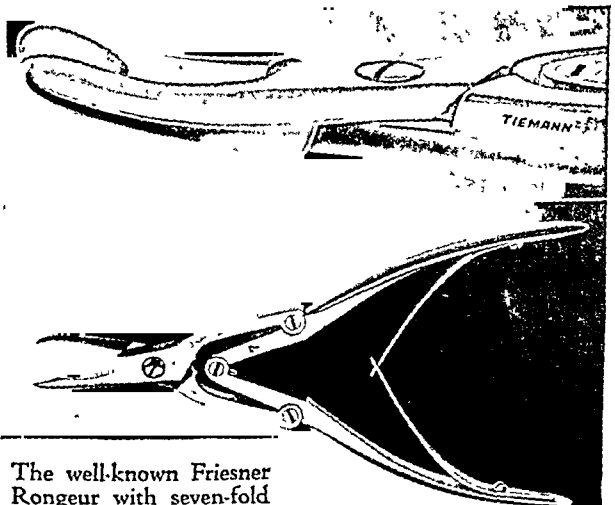
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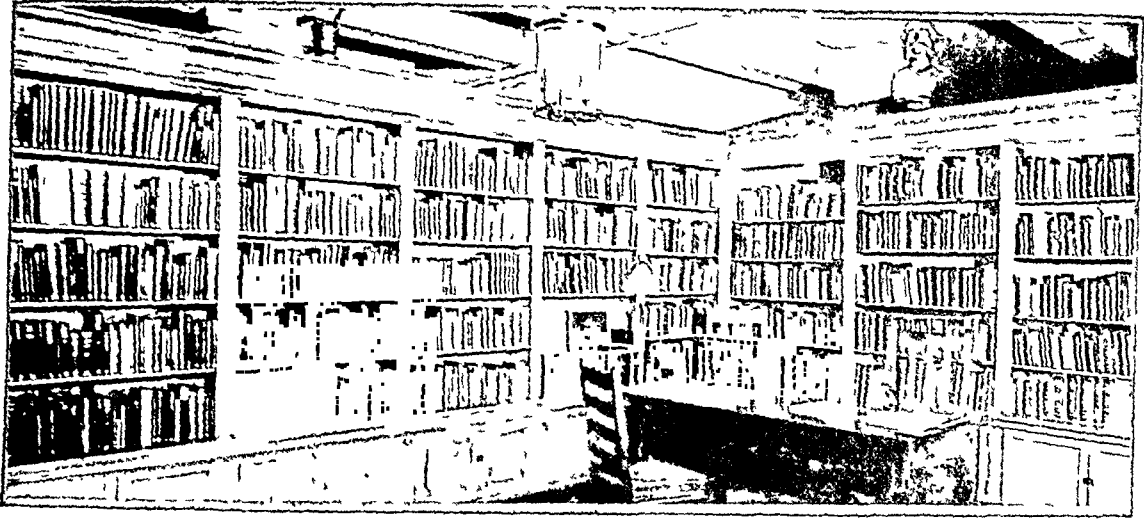
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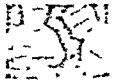
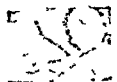
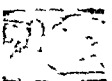
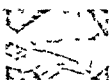

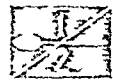
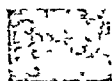
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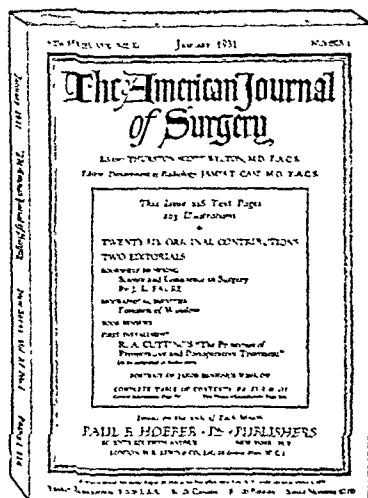
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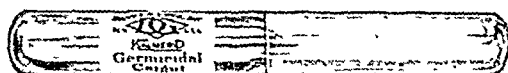
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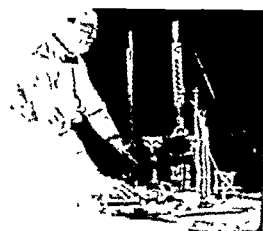


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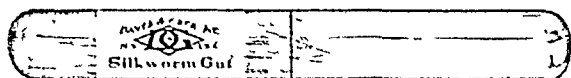
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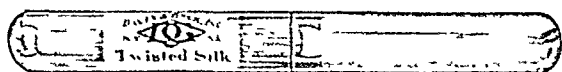


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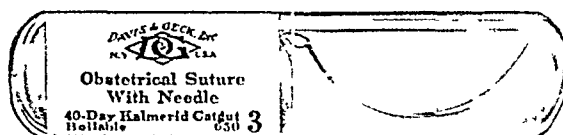
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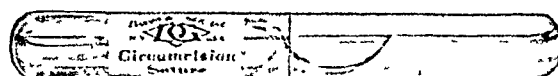
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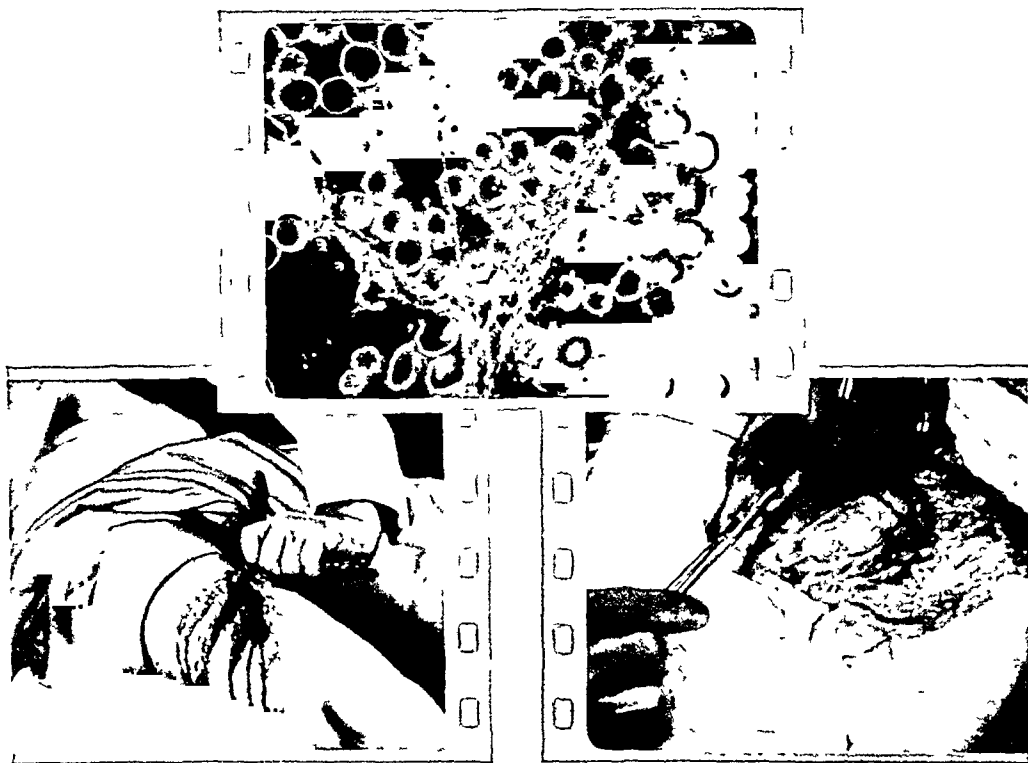
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The American Journal of Surgery

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A Boon to Fracture Work

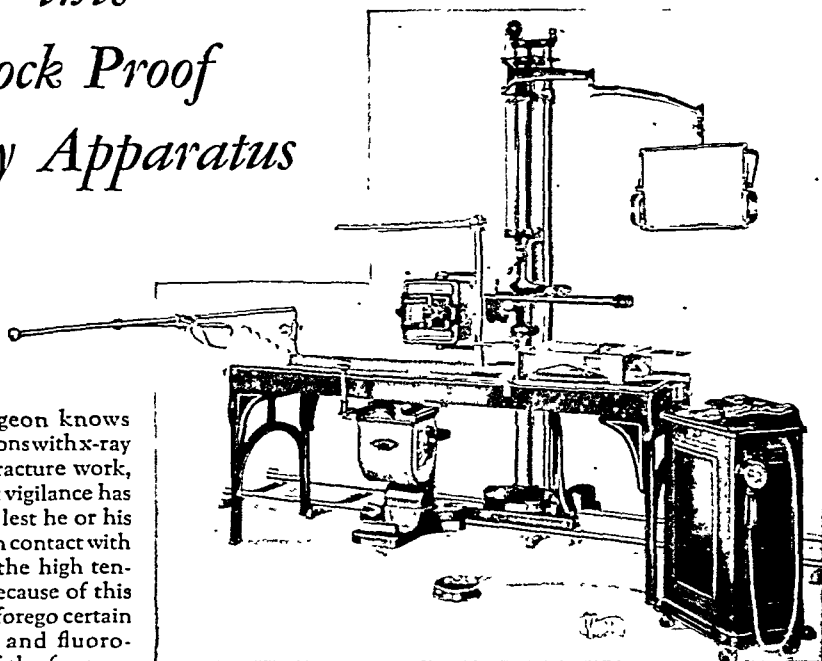
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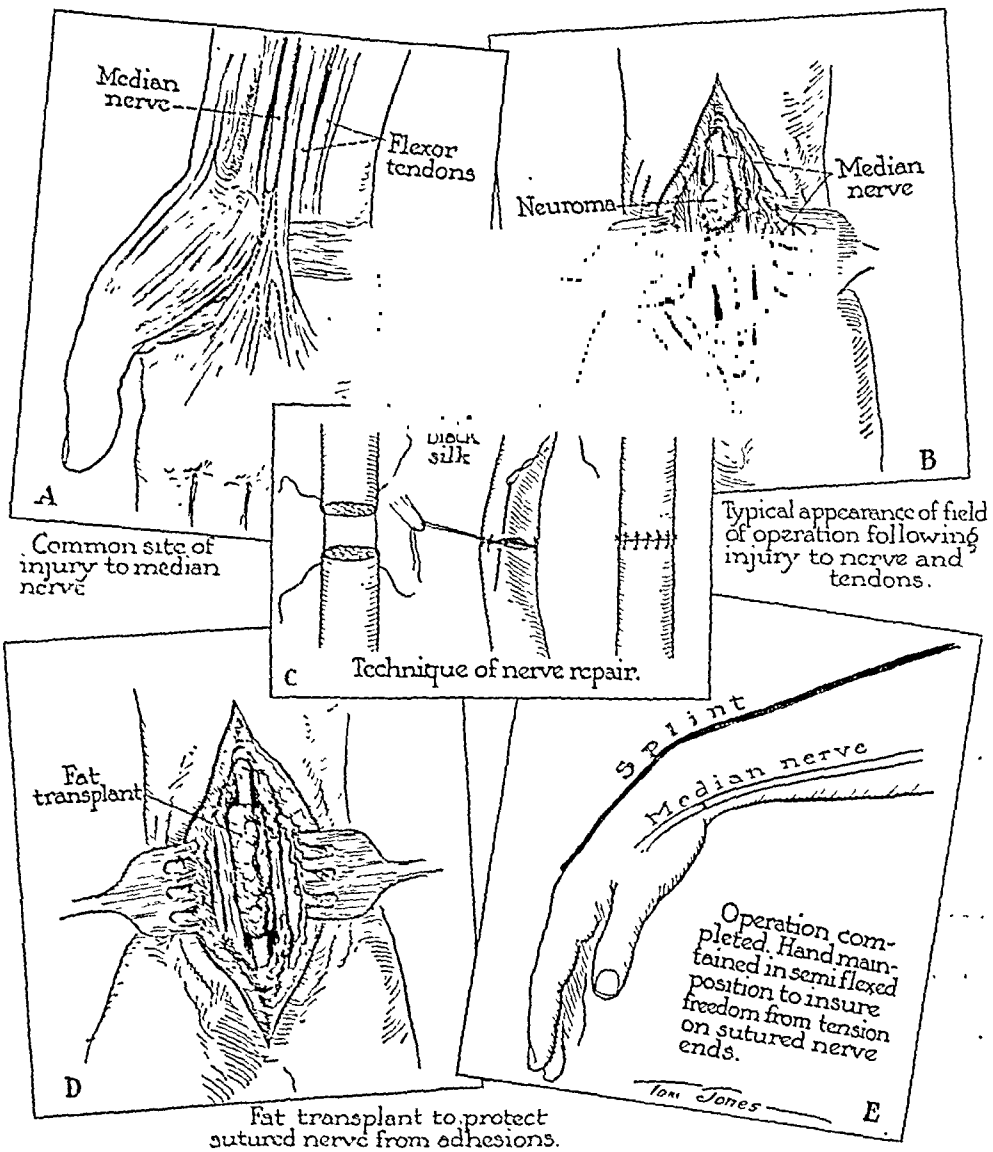
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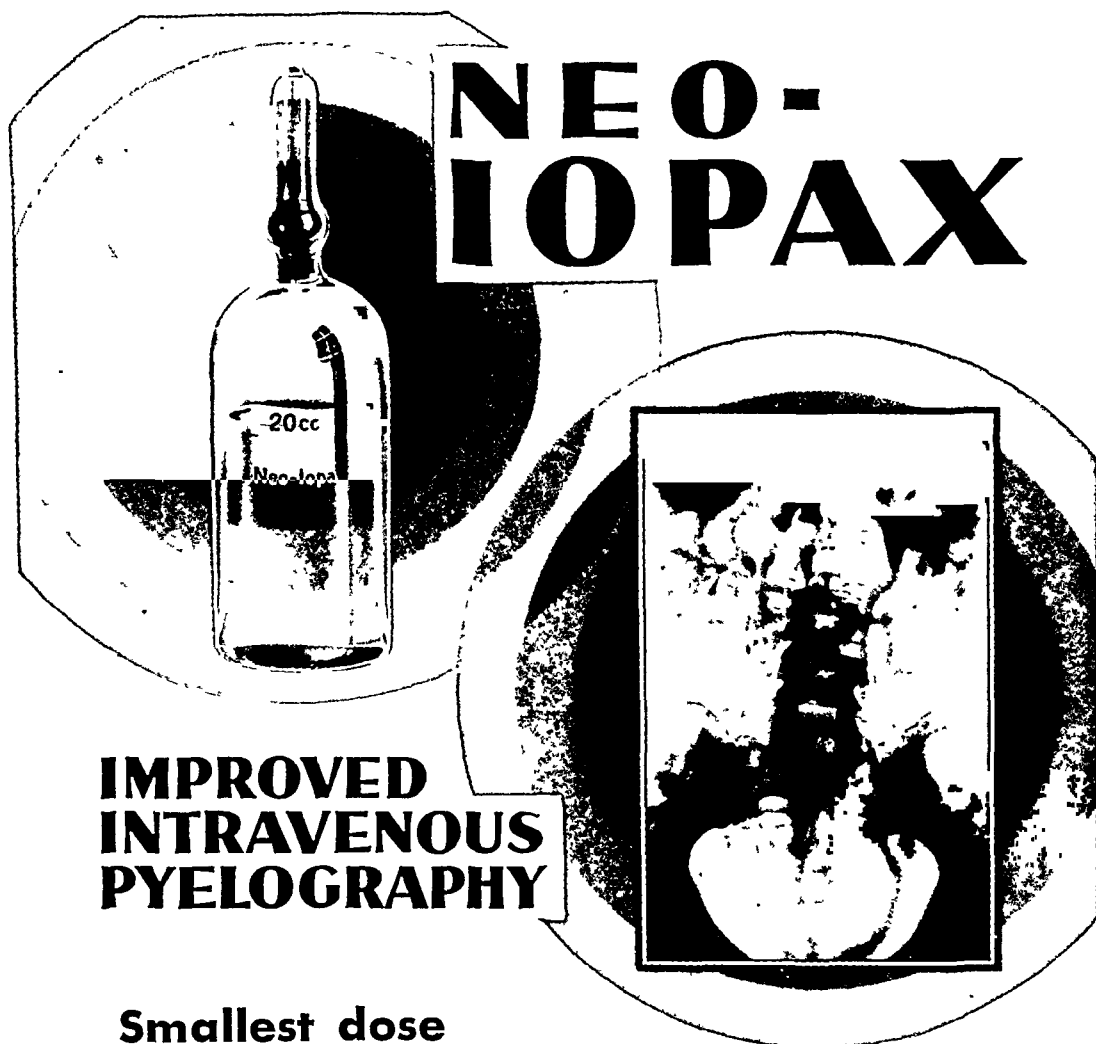


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Russell, T. H.: *Spinal anesthesia. Am. J. Surg.* 6:201, 1929.

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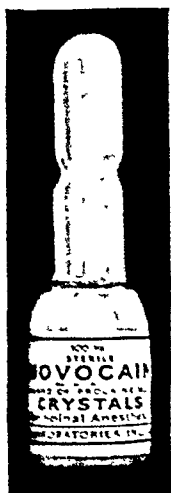
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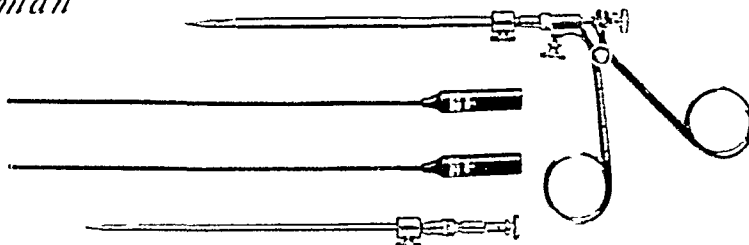
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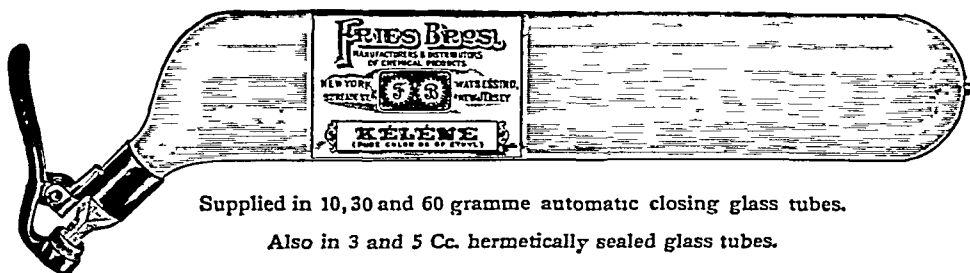
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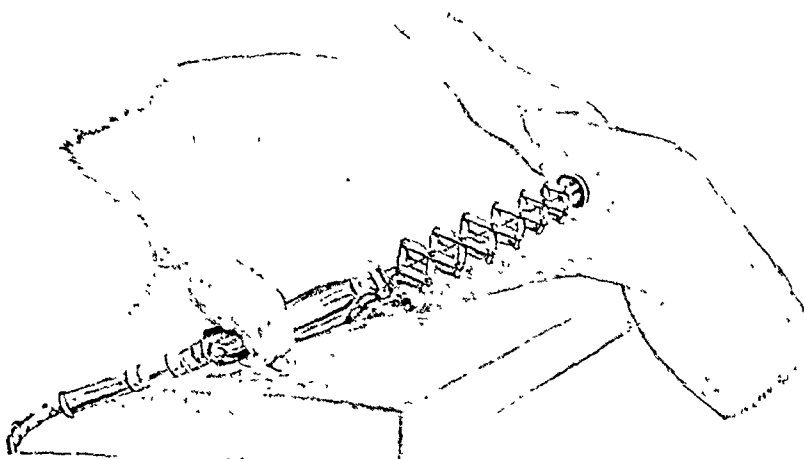
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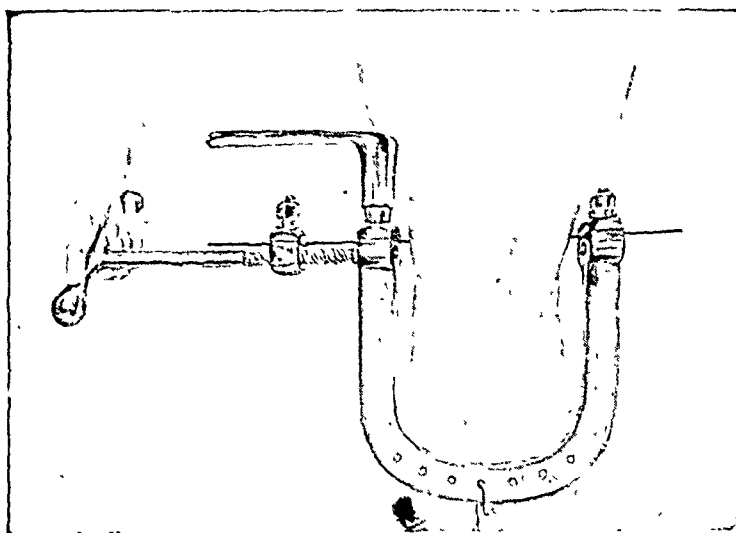
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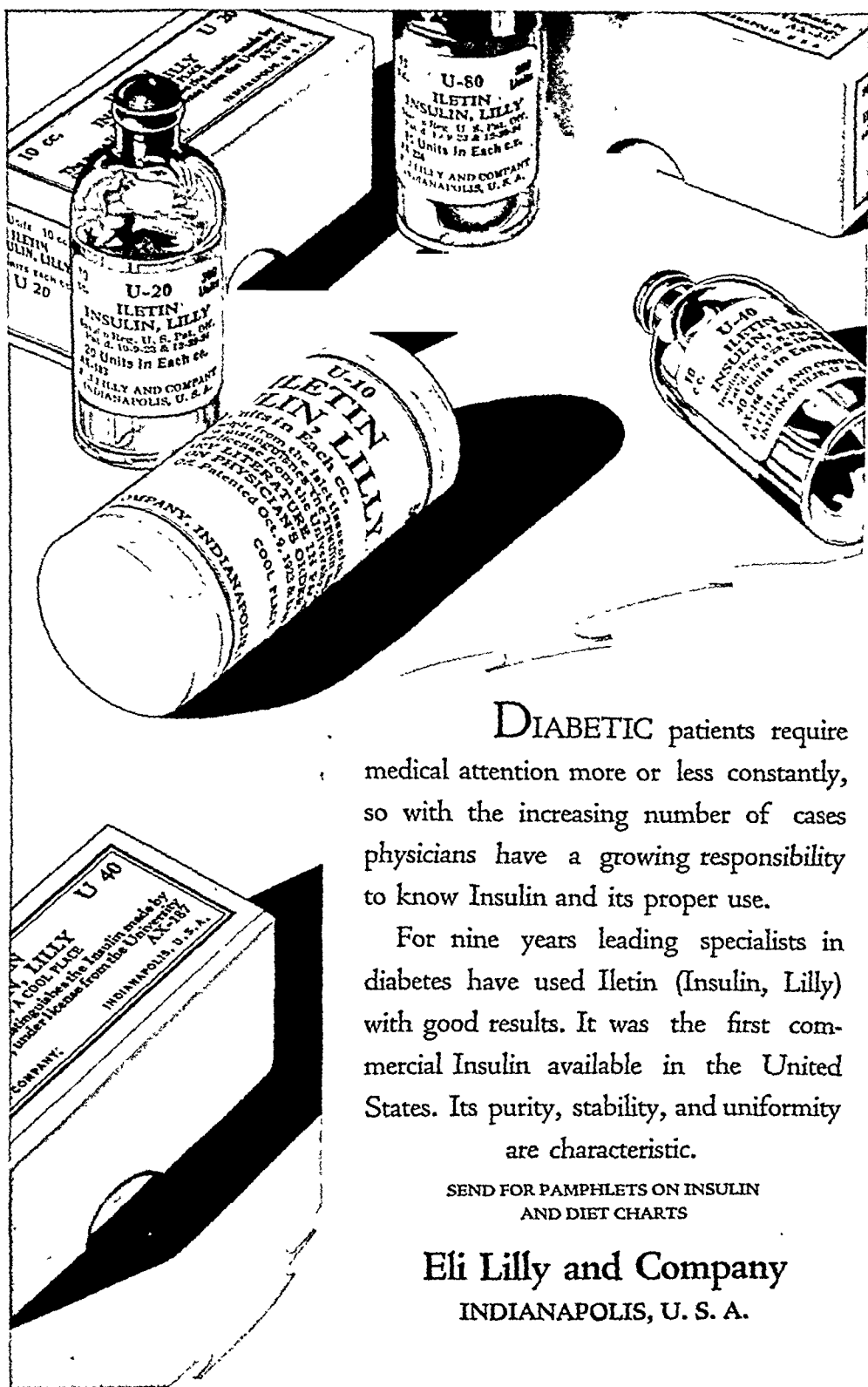
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NEW SERIES, VOL. XIV

NOVEMBER, 1931

No. 2

ABDOMINAL PAIN

PATHS OVER WHICH IT TRAVELS AND WAYS IN WHICH THESE MAY BE BLOCKED*

WALTER C. ALVAREZ, M.D.

ROCHESTER, MINN.

THERE are few problems that worry the gastroenterologist more than that of the patient with severe and perhaps disabling abdominal pain which has not yielded to the usual series of operations on appendix, gall bladder and stomach. What is there left to do in these cases, and how is one going to set these poor unfortunates back on the road to health?

It is of little use to talk about more medicine and more dieting; the patients know that these therapeutic measures are makeshifts, and they have had enough of them. What they want is a real cure, and to get it they are ready to go to great lengths; in fact they are often ready for another operation, and the only reason they do not have it is that the surgeon cannot think of anything more to do.

In the hope of finding some solution of this problem I have for some time been investigating the possibility of blocking the pathways by which sensory impulses leave the abdomen. For several years my assistants and I have been studying the behavior and physiologic properties of the stomach and bowel in animals that have recovered from degenerative section of the vagus and splanchnic nerves,¹ and for some time I have been reviewing what little is known about the anatomy and physiology of the nerves which supply the digestive tract.

I have also been watching with interest and hope the work that my colleagues,

Doctors Lundy, McCuskey, and Tovell in the Section on Anesthesia, and Doctors Adson, Craig, and Learmonth in the Section on Neurosurgery, have been doing in the way of controlling severe and constantly recurring pain, and I have been encouraged by the success that has attended many of the efforts made throughout the world to relieve the pain of angina pectoris.

Some work along the lines to be described here has already been done on patients under my care, but it will be many months before any report of value can be made, and I write now only because I wish to stimulate interest in the problem and to acquaint gastroenterologists with the possibilities of a technique which may be new to some of them.

As will be seen from what follows, many details must yet be learned. The physician and his patient will demand answers to many questions before the one is ready to propose and the other to accept a nerve cutting operation, and unfortunately some of these answers are to be found only after much search in out-of-the-way archives and books. Still more unfortunately, many of the desired answers cannot yet be found anywhere. If what little I have been able to learn and report here helps others to get oriented in the subject I shall be happy.

Obviously, it would be more satisfactory to patient and physician if the cause of pain in liver or stomach or bowel could be

* Read at the meeting of the American Gastro-enterological Association, Atlantic City, New Jersey, May 4, 1931.

detected, understood, and eradicated, but failing this, an almost equally gratifying return to health might perhaps be brought about if, through the sectioning of sensory nerves, the patient were to be rendered unconscious of what is going on in the abdomen. Some may ask: "But isn't there danger in this? Might there not be, sometime, a flareup of infection requiring prompt surgical intervention, and might this not reach a fatal stage before the patient became aware of his danger?" This of course is a possibility, but I think in most cases the danger is so small that it can be disregarded. This should, perhaps, be particularly true in the many cases in which those frequent sources of infection, the appendix and gall bladder, have already been removed.

The greatest difficulty that I am encountering probably comes in locating the pathways which must be interrupted, and the main objection to blocking them is the fact that in order to cut the offending sensory fibers the surgeon has to destroy others, the functions and degree of dispensibility of which are as yet but poorly known.

PATHWAYS OF PAIN

The physician who has long been out of college will probably look on motor nerves, sensory nerves, and sympathetic nerves as distinct entities with clear-cut functions. Actually, all of them are composite; that is, they are bundles of fibers of various sizes and types, all with different functions. Thus, the vagus nerve in part of its course contains sympathetic and sensory fibers, and the splanchnic nerves, which consist largely of preganglionic sympathetic fibers, contain also many sensory fibers and, according to Kuré, fibers of spinal origin but with parasymphathetic reactions to drugs.¹⁶

It seems now to be established that all of the afferent fibers in the sympathetic nervous system are connected with the posterior root ganglia of the spinal cord and therefore no different from sensory

nerves elsewhere in the body; they simply happen to travel in the same sheaths with bundles of sympathetic fibers. Most of those fibers which leave the upper part of the abdomen reach the spinal cord by way of the splanchnic nerves and the white rami communicantes of the thoracic nerves from the sixth to the ninth. In some persons the splanchnic nerves are connected also with the fourth, fifth, tenth, eleventh, and twelfth segments of the dorsal cord.²¹ Blocking of the splanchnic nerves causes anesthesia of the visceral peritoneum and of the organs in the upper part of the abdomen.

The problem of blocking pain in the lower part of the abdomen is even more complicated than it is in the upper part. The pathways are so numerous, so intricate, and so poorly known that in given cases it is hard to find the one involved by disease. The arrangement of the nerves is different in different animals and in the two sexes, and the structures in man are different from those in animals.

Much careful work has been done on the subject by Learmonth, who has found that some forms of pain from the region of the bladder pass up along the sympathetic nerves. Fibers coming on each side from the upper four lumbar sympathetic ganglia join in front of the fifth lumbar vertebra to form the presacral nerve, and from this arise the two hypogastric nerves.

That there are connections between the nerves in the lower and upper parts of the abdomen was shown by Learmonth when he stimulated the presacral nerve and caused pain in a man who, because of the administration of a spinal anesthetic, was analgesic distal to the tenth dorsal segment. According to Learmonth, tactile and thermal sensations pass out of the pelvis by way of nerves which come from the sacral part of the spinal cord.

The problem of producing surgical anesthesia in the lower part of the abdomen has been analyzed by Kroenig and Siegel. Pain fibers to the inguinal region reach the spinal cord through the genitofemoral,

the lateral cutaneous of the thigh, the ilioinguinal, and the iliohypogastric nerves. These are connected with the first three lumbar segments.

The vagus nerves carry so few sensory fibers that they can be ignored whenever efforts are being made to relieve abdominal pain. That these fibers are unimportant is shown by the fact that peritonitis is usually painless in the case of patients who have suffered injury to the upper part of the spinal cord,³⁰ and by the fact that operations in the upper part of the abdomen can be done painlessly under splanchnic blocking. As one would expect from all this, it is useless to try to stop the painful crises of tabes by cutting the vagus nerves. The one symptom that can sometimes be stopped by double vagotomy is vomiting.

That the vagus nerves do carry some sensory fibers has been shown in many ways. Thus, sometimes when a surgeon accidentally injures one of the trunks, the patient will feel pain in the area of the skin distribution about the ear. I can remember a woman with malignant hypertension who, on two occasions when she bled severely from the stomach, suffered with pain about the ear, and I have seen the same pain in a case of cholecystitis. Many such cases have been described by Rasdolsky. Foerster, when he stimulated electrically in man the central ends of the vagus nerves cut below the diaphragm, found that he could produce nausea and vomiting, but not pain. The stabbing frontal pain that many persons feel when they drink ice water is supposed to be due to stimuli reaching the trifacial nerves by way of the vagi.

The phrenic nerves doubtless carry a few sensory fibers which are responsible for the pain which in rare cases is felt in the shoulder during attacks of gallstone colic or in cases of subdiaphragmatic inflammation. Occasionally a phrenic nerve has to be cut for relief of such pain. A good description of this type of distress is given by

Morley in his thought-compelling little book on abdominal pain.

There are still other paths by which pain might conceivably leave the abdomen. One is by way of the ganglionated sympathetic chain, and the other is by way of the aortic plexuses and thence through rami communicantes to the spinal cord in the upper dorsal region.^{14,15} That these sensory connections cannot be very important is shown by the fact already mentioned that when the spinal cord is severed in the upper dorsal region, disease in the abdomen usually runs a painless course. Foerster and others have reported a few exceptions to this rule.

As one can see by glancing at a dissection of the abdominal sympathetic nerves, there are many connections between the central plexuses and the ganglionated chain; so many that a surgeon could never hope to destroy them all. Under the circumstances it is indeed fortunate that most of the sensory fibers from the upper part of the abdomen go out by way of the greater splanchnic nerves. It is fortunate also that most of the fibers in these nerves go directly to the spinal cord without much dispersion in the ganglionated chain.²⁷

For details in regard to the anatomy of the splanchnic nerves, the rami communicantes, and the abdominal sympathetic system, the reader can consult the monographs of Pereira, Wrete, Müller, Gaskell, Langley, Brüning and Stahl, Foerster, and Hovelacque. A valuable source book is the volume on the vegetative nervous system published by the Association for Research in Nervous and Mental Disease, and an excellent summary of recent additions to our knowledge on the subject is to be found in the report of the symposium held at the eighteenth annual meeting of the Gesellschaft deutscher Nervenärzte, published in volume 106 of the *Deutsche Zeitschrift für Nervenheilkunde*.

DIFFICULTIES IN BLOCKING THE PATHWAYS OF PAIN

The great need for more accurate

anatomic knowledge than can be found in ordinary textbooks has been well demonstrated during the search for ways in which the pain of angina pectoris can be blocked. As anyone can see from the diagram published by White, there are at least eight paths from the heart to the ganglionated chain and from thence there are many paths to the spinal cord and brain. If it is difficult to locate these paths in animals, how much more difficult it will be to locate them surely in man.

Difficulties similar to those encountered in locating the sensory pathways in the upper part of the thorax will doubtless be met with when more intensive efforts are made to overcome pain of gastrointestinal origin. With so many pathways available for the transmission of painful stimuli away from the abdomen, it is not always going to be easy to find the place or places in which to apply novocaine or alcohol or the sharp edge of a knife.

As if the difficulties were not great enough, now come Foerster, Shaw, and others with evidence to show that even the anterior roots of the spinal cord carry sensory fibers. In many instances these roots have had to be cut together with the posterior ones in order to relieve severe pain due to traumatic neuromas or carcinomatous metastasis. Under normal conditions most of the sensations of pain seem to travel by way of the posterior root, but when this path is blocked there appear to be, in many persons, alternate ones which can be used.

Shaw, in a discouraging article recounts many cases in which posterior rhizotomy either failed to relieve or else relieved only for a while.

Frazier noted also that "There is a curious variability in the effects of dividing a given number of roots in any series of cases . . . In some one finds a partial, in others a complete anesthesia; in some it is transitory, in others permanent, and in others again there is hyperesthesia."

Unfortunately, in many cases, even when both the anterior and posterior spinal roots

are cut, pain will continue to be felt in a region which is so completely anesthetic that operations can be done in it without discomfort to the patient. Foerster has reported the case of a man who, even after a complete break in the continuity of the spinal cord, continued to suffer with pain in the legs and to feel something when they were pinched. In such a case the afferent pathway for peripheral pain, if such it was, must have been along the nerve plexus in the walls of the blood vessels.

Cordotomy. On account of the many difficulties involved in the blocking of peripheral pathways of pain, a number of neurosurgeons have of late turned to the operation of cordotomy which is designed to interrupt the conducting tracts between the posterior roots of the cord and the brain. It has long been known that the fibers which carry sensations of pain are gathered together in the anterolateral columns and when these are cut, the ability to feel pain in parts distal to the break is more or less completely lost. Whenever possible, this operation is done under local anesthesia so that the surgeon can control the depth of his cut by the extent of analgesia produced. Shaw concluded that the frequent failures seen after posterior rhizotomy and the better results obtained with cordotomy should cause the surgeon to look on the latter as the operation of choice in all cases of widespread, incapacitating pain in the lower half of the body.

Unfortunately, the cut must be made on both sides of the cord because the sensory paths zigzag back and forth all the way up to the brain. More work needs to be done to make sure of the effectiveness of cordotomy in relieving different types of abdominal pain and distress. Davis, Hart, and Crain, who worked with dogs, found that cordotomy did not relieve the pain produced by distention of the bile ducts, but Spiegel and Bernis, who worked with cats, found that it did put a stop to the respiratory reflexes which are observed when the bowel is stimulated. There is evidence to show that pains of different

types travel along different paths, and until exact knowledge is at hand, some of the operations that are done are bound to be disappointing.

METHODS OF LOCATING THE PATHWAYS OF PAIN

With the patient in an attack of pain our usual procedure at The Mayo Clinic is, first, to see whether the sensory paths involved are on the right or the left side or on both sides. If the pain is limited to one side or to one quadrant of the abdomen, the problem of locating the sensory paths is comparatively simple. If the pain is central or widely distributed, it may be possible to find a zone of hyperesthesia on one side, but too often this is absent. Possibly in some cases zones could be found in which the pilomotor nerves or those supplying sweat glands function abnormally.

The next thing to do then is perhaps to inject about 0.5 per cent novocaine solution around one or other of the splanchnic nerves. This form of anesthesia, originally worked out by Kappis, Læwen, Preiss, and others, is being used at this clinic every day, and in the hands of experts appears to be practically without danger. If the pain is promptly relieved by splanchnic block on one side the anesthetist can later use paravertebral block to determine which of the dorsal segments are involved.

In many cases it is well first to induce spinal anesthesia. The anesthetist and the neurologist will then watch the analgesia as it rises step by step on the trunk, so as to note the level reached at the moment when the pain ceases. They will often watch also for the return of the pain as sensation gradually creeps back. In this way they can identify the segment farthest oral through which the pain-carrying fibers pass out to the cord. Later, paravertebral blocking may be employed distal to this point.

Such experiments at blocking serve to indicate, first, that the pain is or is not of peripheral origin, and second, that it is coming from a restricted part of the

abdomen corresponding to one or more spinal segments. Information thus secured will often have diagnostic value and will help in incriminating or exculpating certain of the abdominal organs.

When, in a given case, it is shown repeatedly that blockage of the nerves on one side at a certain level will stop the pain, the patient can be fairly certain of securing permanent relief from an operation in which either the white rami communicantes or the posterior (and perhaps also the anterior) roots are cut. There are a few cases on record in which, for some unknown reason, one injection of novocaine gave lasting relief from pain.^{18,19,42} In other cases the injection of 80 per cent alcohol gives relief which lasts usually for months; it is possible that sometimes it may be permanent. The anesthetist leaves the needles in place until he sees that with novocaine satisfactory anesthesia can be obtained, and then he injects the alcohol. Unfortunately, in some cases, alcohol does not give as satisfactory anesthesia as that with novocaine introduced at the same point; the explanation probably is that alcohol does not diffuse so widely as does the novocaine. For this reason it is a good plan not to introduce alcohol unless anesthesia has first been obtained with an injection of only 1 or 2 c.c. of novocaine solution. Then the anesthetist can be fairly sure that the needle is in the right place.

With nervous, apprehensive, and hypersensitive patients it is, I think, wise to insert the needles under nitrous oxide anesthesia and then to inject perhaps 1 c.c. of the novocaine solution. The patient is then allowed to wake so that he or she can report on the disappearance or persistence of the pain as the injections are made at the different levels. A few whiffs of nitrous oxide are particularly desirable when alcohol is to be injected, because the pain then produced, although transient, is severe.

Future study alone will show what is the best type of operation to be performed in the cases in which sensory paths must

be interrupted permanently. One can think of several places in which the break might be made: in the greater splanchnic nerves, in the white rami communicantes, or in the posterior roots of the spinal nerves. Unfortunately, wherever it is made the surgeon must destroy a number of fibers which he would rather leave intact, and the problem is to cut where the least damage will be done and where the operation will be technically simplest and freest from danger.

The cutting of the greater splanchnic nerve has been performed so seldom in man that thus far most of the studies in regard to the technical approach have been made on the cadaver. Three approaches have been proposed; one trans-thoracic, just above the diaphragm,^{27,52} one through the space behind the diaphragm,⁶⁵ and one through the space above the renal artery.⁵¹

The cutting of the greater splanchnic nerve must involve the destruction of preganglionic fibers to blood vessels, glands, and smooth muscle. When only two or three spinal segments are involved, von Gaza's operation on the white rami might be advisable as it calls for the sacrifice only of those parts of the splanchnic bundle that come from the affected organ. It has the advantage that the spinal dura does not have to be opened, but the disadvantages that the thorax has to be entered and that the white rami cannot always be identified. Pieri avoids this difficulty by removing part of the ganglionated cord, but this involves the destruction of many fibers which go to make up the greater splanchnic nerve.

Foerster's operation of section of one or more posterior roots has the advantage that it preserves the sympathetic fibers leading to the abdomen. One disadvantage is that it destroys sensation in the affected dermatomes, and the other is that it often fails to relieve.⁶⁷ Fortunately, when only one or two segments are involved there may be little if any analgesia in the skin on account of the overlapping of distributions.

This operation is usually of little value in cases of tabetic crises because in this disease the source of the pain is probably in the spinal cord itself. Actually, as Hanser has shown, in some tabetic patients the viscera are already insensitive. This was to be expected from Roux's discovery that in these patients many fibers in the splanchnic bundle are degenerated.

If Kuré is right, section of the posterior roots must destroy a large bundle of efferent fibers to the abdomen, fibers which he believes have trophic functions. Frazier has stated, however, that he has never seen trophic changes after posterior rhizotomy. Section of posterior roots low in the lumbar region will produce some ataxia of the legs, and section of anterior roots will cause paralysis of abdominal or leg muscles.

RESULTS OF SECTION OF VARIOUS NERVES IN ANIMALS AND MAN

As yet, too little is known about the end-results of the various types of neurotomy in man; we know that it has been done and that some of the patients remained cured for a time, but it will be well to watch many of the patients for years to see how they get along.

Because of the great differences between the structure and functions of the various nerves in animals and man, the surgeon who is operating on man cannot safely draw conclusions from anatomic and physiologic studies made on animals, but must, as opportunities arise, obtain what knowledge he can by studying men and women in whom disease or injury or operation has altered conditions in the nervous system or exposed nerves so that they can be stimulated. Unfortunately, also, different persons vary so much in the structure and functions and sensitiveness of the nerves that results obtained in one patient cannot always be duplicated in another. Much more knowledge is needed, and until it is obtained some of the operations to which patients are now being driven by pain and suffering will have to be disappointing.

Bilateral vagotomy has been done several times in man, usually in the hope of relieving the nausea and vomiting of tabetic crises.¹²⁻¹⁵ The vagus nerves are commonly destroyed also during high gastric resections and there do not seem to be any deleterious after results. Reich and Zesas who reviewed the literature on the subject, both came to the conclusion that unilateral vagotomy in man has no demonstrable influence on health.

In animals the section of these nerves commonly lowers the tone of the stomach and the degree of acidity of the gastric juice, but neither of these changes is permanent.

Splanchnicotomy has been done several times in man, apparently without deleterious results. Foerster speaks of having performed the operation on tabetic patients without results, good or bad. Pieri, in 1929, reported resections of the right major and minor splanchnic nerves. After this work the stomach seemed to have better tone and better emptying time, and the intestines functioned well. In one case severe constipation was relieved. Mixter and White reported having cut the splanchnic nerve on one side with good results.

Many experimenters have cut one or both major splanchnic nerves in animals and several have experienced a high mortality. Even when the animals recovered from the immediate effects of the operation many of them suffered with diarrhea, they became greatly emaciated and went on down hill. Other animals which recovered from double splanchnicotomy were frail and unable to stand the shock of subsequent operations.²⁴ A few physiologists, however, reported that this has not been their experience.³¹ The experience of Mann and Ivy is that the operation is well borne by cats and dogs but not by rabbits. There is no question in my mind about the seriousness of vagotomy and splanchnicotomy in the rabbit, but this animal seems to be particularly susceptible to such operations, possibly

because of the resultant prompt emptying of the large and highly important cecum.

There is some evidence that destruction of the splanchnic nerves interferes with the secretory functions of the pancreas. Baxter found that in the rabbit it greatly reduced the strength of the enzymes in the pancreatic juice. Ordinarily the changes which it produces in the blood supply of the bowel are transient. My own experiments on rabbits have convinced me that in this animal double splanchnicotomy is a very serious operation. The bowel appears to be so active that it cannot hold the food long enough for proper digestion and absorption. Many experimenters have found ecchymoses and even gastric ulcers in some of the animals (particularly in rabbits) in which the vagus or splanchnic nerves were cut.

Cannon has removed, in cats, the whole sympathetic ganglionated chain on both sides of the spinal column and has kept the animals fat and sleek for months afterward. He does not look on the operation as a serious one. The main handicap that these cats have is their inability to adjust themselves to cold; they cannot fluff their fur, and they cannot quickly warm themselves by speeding up the metabolic rate. The females can bear young, but because of trophic changes in the breasts they sometimes cannot nurse them. Learmonth tells me that in men lumbar sympathectomy or section of the presacral nerve does not affect potency or ability to have orgasm; it interferes only with ejaculation.

In dogs double splanchnicotomy does not seriously affect the blood pressure.⁹ It is possible that in man it might interfere with the mechanism which quickly adjusts blood pressure to changes in posture. Crile, who for some time has been cutting the nerves to the suprarenal glands, wrote me that he has not seen any deleterious effects from the operation.

Koennecke, Popielski, Peiper, and others who destroyed the celiac ganglia, found this to be a very serious operation; the

mortality was high and it was hard to keep the animals alive. Much of the food went through the bowel undigested, possibly because the denervated bowel was too active and too responsive to every stimulus. In addition there were disturbances of secretion in pancreas and bowel, the vasomotor control of the blood vessels in the abdomen was much disturbed, and the feces were full of blood. Peyer's patches in the bowel sometimes became atrophic. In Popielski's experiments the gastric and pancreatic secretions were not changed.

A review of much of the literature on the results of section of the nerves to the stomach and bowel will be found in the articles by Koennecke, Bunch, Hartzell, and McCrea. My impression is that more work must yet be done on man before anyone can say how safe it is to cut both major splanchnic nerves.

DIFFICULTIES IN THE WAY OF FURTHER RESEARCH

Unfortunately, there are several difficulties in the way of devising and testing operations for the relief of patients with intractable abdominal pain. In the first place the work, in order to be convincing, will have to be done by conservatively-minded men who will not become too enthusiastic over a few, perhaps temporary, good results, and who will choose their cases with care. The patients will first have to be studied with thoroughness so that later, when clinicians read the reports of the work, they will not be saying, "Why, that woman should never have had a nerve section; she should have had her gall bladder removed, or she should have been given a rest cure." While reading the optimistic reports of Pieri, I often found myself wondering if a particular patient with "gastric atony" should have been operated on, or if the cure reported at the end of a short period of observation was going to be permanent. Few men seem to realize that in many cases any operation

is likely to give relief for from three to nine months.

During the last few years I have seen a number of patients who, it seemed to me, might well have profited from the resection of sensory nerves, but in most instances I refrained from suggesting any attempt along this line because the individual was neurotic, psychopathic, or constitutionally inadequate, and therefore a poor subject for surgery. In other cases, especially in which migraine was a factor in the disease, I could not be sure that the relief of abdominal pain would work a cure.

In order to learn something definite about the value of temporary or permanent nerve blocking, one would like to work with patients who are coöperative and intelligent, who are likely to stop complaining when the pain lets up, who are ready to accept the risks of experiment, and who will not be annoying or vindictive if the operation does not do all that they hope it will do, or if it leaves them with annoying analgesia or paresthesia.

In many cases it will not be easy to learn where the nerve blocking or sectioning should be done, and in others the patient, after submitting to one or more somewhat painful and nerve-racking paravertebral injections, may refuse to go on with the study. It may be that nerve section would bring relief to some of those persons who now suffer with intractable duodenal and especially gastrojejunal ulcer, but for many of them it could hardly be advised because of the danger of silent perforation into the colon or other neighboring organ.

Fortunately, in expert hands, rhizotomy does not carry much surgical risk and the preliminary laminectomy does not seem to weaken the spine.

More histologic studies must be made on abdominal nerves and ganglia removed after death or during operations on patients with unexplained abdominal pain, and the surgeon and the pathologist will have to keep a better watch for disease of these structures. Scarring lesions have been

found in the sympathetic ganglia,* lesions which might easily give rise to pain. Strange to say, the large sympathetic ganglioneuromas do not ordinarily cause pain,† but those of von Recklinghausen's disease sometimes do. As Wohlwill says, the discouraging feature is that serious degenerative changes can sometimes be found in the sympathetic nerves of patients who died uninterestingly of well-known diseases, while nothing wrong can be found in ganglia removed for the relief of severe neuralgia, asthma, or angina.

The problems taken up in this paper are not easy to solve and much remains to be done; most of the patients with unexplained abdominal pain are not sick enough to require or to accept nerve-blocking measures, but some of them are incapacitated, and I believe the time has come when the gastroenterologist should at least be aware of the fact that the neurosurgeon might be able to help him. As Grant has pointed out, when the neurosurgeon can be of help he should be given a chance to see the patient before he or she has become

so demoralized by suffering that nothing really curative can be attempted.

SUMMARY

There are many patients with severe, as yet unexplainable, abdominal pain who might perhaps be relieved by some form of nerve blocking. The present article represents a brief summary of what is known about the ways in which such blocking might be done.

The pathways of sensory fibers leaving the abdomen are outlined. Most of these fibers leave by way of the splanchnic nerves. The technique of cutting the various nerves or of blocking them with novocaine and alcohol is briefly described, and the results of such operations on animals and men are reported.

Many difficulties remain to be overcome and much needs to be learned about the possibilities and limitations and disadvantages of nerve sectioning. Great care will have to be exercised in choosing patients for study or operation, and good sense and conservatism will later have to enter into the judgments made as to the results of the treatment.

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[For Remainder of References see p. 430.]

THE INJURED ABDOMEN*

A CONSIDERATION OF VISCERAL INJURIES DUE TO TRAUMA WHERE THE ABDOMINAL WALL HAS NOT BEEN PERFORATED†

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INTRODUCTORY

IT is believed by competent observers that intra-abdominal injuries are increasing in frequency. The automobile appears to be the chief *causus belli*, but it must not be made the scapegoat for all the lacerated livers and torn spleens. Coasting accidents, falls upon the flat of the back or against objects, football and baseball injuries, kicks by domestic animals, and boxing must all take their share of the liability for the carnage.

The subject of visceral injuries has created more controversies and bitter disputes than any other recent theme of consideration in the surgical journals. We have undertaken to review the recent polemic literature concerning these injuries, correlate it with our own experiences, and attempt to strike a balance.

All the case histories in this paper are from the records of the Robert Packer Hospital, Sayre, Pa., and have been used with the kind permission of Dr. Donald Guthrie.

We wish to acknowledge our appreciation to Dr. Donald Guthrie, Dr. George Hawk, and Dr. Charles DeWan for their valuable suggestions and assistance in the preparation of this monograph.

PART I. GENERAL CONSIDERATIONS

I. THE PROBLEM. To better visualize what can happen when the abdomen is subjected to trauma, we like to think of the abdominal cavity as a basket of eggs covered with a sheet. The injuries we are discussing are that type in which the eggs are cracked or broken without the sheet's being torn.

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A laparotomy is a serious affair, especially in children, and entails a very definite risk. The anesthesia, operative shock, and the omnipresent danger of postoperative adhesions or hernia in the long exploratory incision, are all taken too lightly by many men. The opinions presented in recent medical literature are most confusing, and swing precariously from ultraconservatism to ultraradicalism. An impartial review of recent papers reveals the following facts:

1. All are agreed that operation should be deferred until the primary shock has subsided.

2. Opinion is widely divided as to the advisability of an exploratory laparotomy.

3. All are agreed as to the difficulties surrounding diagnosis of subcutaneous visceral injuries due to trauma.

The problem, then, is one of more efficient diagnosis. Since most of the controversy concerns the exploratory laparotomy, any further addition to the literature of this subject should deal with maneuvers which would tend to make exploration less necessary.

II. THE ABDOMINAL WALL. The wall of the abdomen is a musculotegumentous sling in which the viscera, together with their blood and nerve supply, are hung from the bony framework of the body.

The skin, because of its elasticity, does little of the actual supporting, as witness its flabbiness in the hernias and its tendency to tear with the formation of striae during pregnancy, or in the presence of a large tumor, or in obesity. Conversely, it is of little protection to the viscera against external assaults.

It will be recalled that the points of least resistance, so far as the thickness of the abdominal wall is concerned, are have cutaneous as well as muscular branches. It is difficult to imagine any injury of the abdominal wall not involving

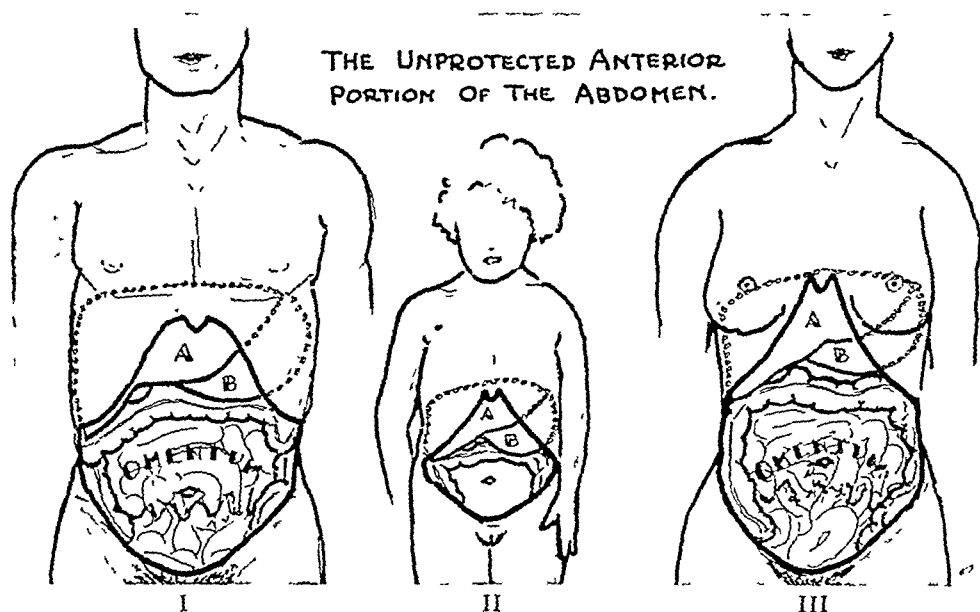


FIG. 1. Unprotected anterior abdomen. I. Male adult. II. Child. III. Female adult. A. Liver. B. Stomach.

the linea alba and the lineae semilunares. These areas extend longitudinally over the abdomen. Only in very rare instances does the traumatic force strike parallel to one of these lines, for the great majority of abdominal wounds are *across* the abdomen. Because of this, the bulk of the abdominal muscles and subcutaneous fat is thrown in the path of the invading force, and sharp, cutting force is transformed into dull, crushing force. Only the slender individual, with flabby abdominal muscles and no subcutaneous fat, is subjected to visceral injuries due to sharp, cutting force. About 95 per cent of non-penetrating abdominal injuries are due to crushing or hydraulic force.

The unprotected area of the abdomen consists of a diamond shaped area bordered cephalically by the angle of the ribs and caudally by the angle of the iliac crests. Across this area extend the intercostal, iliohypogastric, and ilioinguinal nerves. These nerves ramify the abdominal muscles. It is well to remember that they

these nerves, which therefore have an important bearing upon the interpretation of symptoms following an injury.

In obesity, the weight of the subcutaneous fat and a fatty omentum drags upon the abdominal wall causing it to bulge below and to become stretched and thinned above. The upper abdomen of the fat man, contrary to popular opinion, is therefore no better protected from trauma than that of the thin man.

The tonicity of the abdominal muscles has much to do with the protection of the viscera. Witness the sudden spasm of the muscles upon a dash of cold water to the skin. In muscular individuals the abdominal muscles have a very real protective potential. Fright causes contraction of many muscles, including the abdominal recti. In the fraction of a second before the crash the driver will utter a gasp, hold his breath, and "freeze" to the steering wheel. We have all seen motion pictures of professional strong-men who stand brazenly with bared abdomen and with-

stand battering rams wielded by three or four men.

The abdominal wall lies very much closer

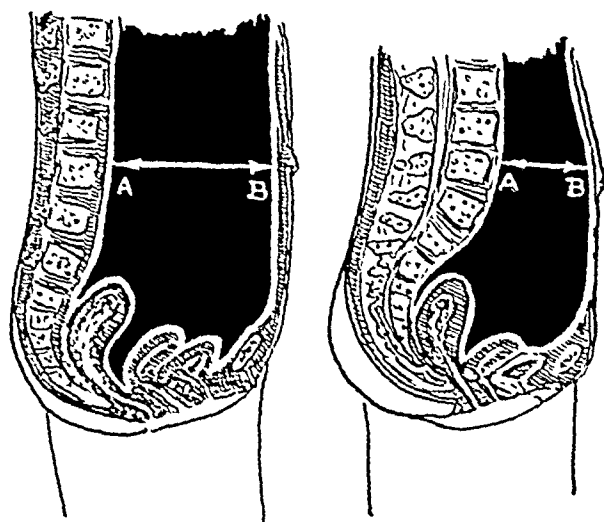


FIG. 2. Left, usual conception; right, actual frozen section. AB, distance from belly wall to bodies of vertebra.

to the bodies of the lumbar vertebrae than we usually think. This will become convincingly apparent upon examination of sagittal frozen sections. This proximity is even more marked in children, where the two structures may lie but 3 cm. apart.

The bony prominence of the lumbar vertebrae is padded with prevertebral fascia, much areolar tissue, the elastic, tense aorta, and the root of the mesentery, but this padding is more the consistency of a well rounded boxing glove than of a Charles of London chair. It is not such a cushion as one might suppose.

Of the posterior wall of the abdomen there is little to say here, except that the primates are the only mammals for which this thick buttress of bone and muscle avails nothing so far as protection from usual assaults is concerned.

III. THE MECHANICS OF VISCERAL INJURIES. Solid organs such as the liver, spleen, pancreas, or the normal kidney may be torn by direct or transmitted force just as the brain is lacerated by a blow which need not crush the skull. The pancreas is probably the best protected of this group, and is badly damaged only in those

extensive injuries which are usually instantly fatal. The liver and kidneys are possessed of tough limiting membranes (capsules), which tend to make these organs somewhat elastic. The spleen possesses no such protective membrane; its limiting membrane is so fragile and thin as to be undeserving of the name "capsule" as we ordinarily understand this term. Moreover, the spleen is of granular consistency, and hangs from a pedicle much as an apple hangs from a tree. For these reasons we find damage to the spleen more frequently than we do fractures or tears of the liver or kidney.

The results of a crushing force applied to elastic and non-elastic objects are quite different. We do not say that the liver and kidney are elastic and that the spleen is non-elastic; the comparison is one of relativity. The spleen is *less* elastic than the others.

A solid organ may be torn from its pedicle by direct force (stretching beyond the pedicle's limit of elasticity), or by the whipping action of the recoil. An apple may be either knocked from its tree or shaken off.

All this may at first appear to be very elementary, but it explains very satisfactorily why we see such severe splenic destruction (the spleen torn asunder and lying free in the peritoneal cavity or ruptured into three or four fragments) with comparatively slight traumatic force, while injuries to the liver and kidney may be inconsiderable following extensive trauma.

Hollow viscera are most frequently injured by bursting. Because such injuries are due to the transformation of a blow into hydraulic force, any condition such as distention of a viscus favors such injury. A normal stomach, greatly distended after a meal, and further distended by the ingestion of considerable fluids, is especially susceptible to injury. Consider the liability of the bladder to rupture when greatly distended.

The possibility of bruising the intestinal

wall by crushing it against the vertebral bodies has already been mentioned, and will be discussed in more detail later. Such

normal viscera, it is readily seen that pathology of the organs makes injury all the more likely. The greatly enlarged,



FIG. 3. Flank damage by a rumble seat. Arrow indicates direction of blow imparted to area containing spleen and left kidney when occupant thrown against side of seat compartment.



FIG. 4. Epigastric damage by a rumble seat. Arrow indicates direction of blow imparted to area containing lower edge of liver, gall bladder, and stomach when occupant thrown against forward edge of compartment.

a contusion is the cause of delayed rupture of the intestine reported occasionally.

There is a very real danger of mesenteric injury following blows to the abdomen. Although I have seen but one instance of this, I believe that such injuries occur more frequently than we suspect. Certainly the mesentery of the jejunum and the ileum is analogous to the pedicle of the spleen, and like trauma should produce like results.

All of us know how rapidly a hematoma will form when a small vessel bleeds beneath the serosa. Also we know how little trauma is needed to tear these retroperitoneal vessels. The mechanism of injury to these vessels is merely the stretching of them beyond their limit of elasticity, the stretching being induced by either force or contra-force. Since such an injury is so easily induced it is not strange that many men report that they find retroperitoneal hematoma to be the most frequent injury in the traumatized abdomen.

Occasionally the sharp end of a fractured rib may perforate the diaphragm and tear a hole into the stomach or intestine.

After such a discussion of injury to

tense spleen of malaria or uncinariasis will be easily fractured. An enormous liver, extending well down to the umbilicus, and rendered brittle by cirrhosis, can be very easily torn. A very slight jolt from the arm-rest of a rumble-seat is all that will be necessary to rupture a pyonephrotic kidney. Very minimal jarring may cause the perforation of a gastric or duodenal ulcer.

It is well to keep in mind the ease with which a spontaneous fracture of a carcinomatous bone occurs. One can never then minimize slight trauma to an abdomen which may possibly contain pathologically weakened viscera.

IV. THE CLINICAL PICTURE OF INTRA-ABDOMINAL INJURY. The astounding thing about severe non-penetrating injuries of the abdomen is the fact that primary shock is so mild. Commonly the injured will walk from the scene of the accident with pieces of a ruptured liver or spleen lying free in the abdominal cavity. Frequently they are taken to physicians' offices or hospital dispensaries, examined, and sent home. When questioned, they say they feel tired, or have vague, ill-at-ease sensations. Usually they have very little pain or discomfort. Examination, even when most

carefully done, may show absolutely nothing. There may not even be an abrasion. Ecchymotic areas will not develop for a day or more.

Secondary shock is as severe and terrifying as the primary shock is mild. It develops rapidly once it is under way. The patient feels faint, nauseated, and wants to lie down. Often he falls over in syncope. When seen soon after this, the patient is pale, restless, the skin is cold and moist, and there is marked thirst or even air-hunger. Anything he attempts to drink is vomited. His pulse is above 100 and feeble. The abdomen begins to show signs of distention.

Soon very definite signs of visceral injury become apparent. Hemoglobin, red blood cells, or bile may appear in the urine. Jaundice may develop. Usually there is a leucocytosis with a preponderance of the neutrophils. The abdomen is increasingly rigid. There may or may not be distention. Always there is either generalized or localized tenderness. Since these signs are the only tangible things upon which we must depend for diagnosis, they will be discussed more fully later.

The onset of symptoms has been so abrupt and the patient has had such a horrifying time that relatives are frantic. They want "something done" immediately upon the patient's admission, at which time he is usually in severe shock and least able to withstand any operative procedures. The relatives have been taught that immediate operation is the expected thing in such cases, and it is difficult at times to persuade them otherwise. Now is the time for cool and careful reasoning on the part of the surgeon. He must not be coerced into doing something his better judgment tells him not to do, even though the insistence of misguided parents or friends is most strenuous. Certain things, if explained to the most impossible families, will make them docile and cooperative. It should be explained, for example, that an operation should have but one object in view, namely, doing something which will

alleviate the suffering and make the convalescence more rapid. When nothing definite can be done, tinkering is dangerous. An unwise operation cannot be remedied, only regretted after the patient dies. The "maybe" policy is fatal in these cases.

V. THE DIAGNOSIS. Accurate diagnosis is the key to the riddle. This diagnosis should be built carefully and slowly, weighing and shaping each sign and symptom until a clear and definite conclusion is reached. Then and only then should we speak of treatment except for primary shock. We must not neglect the badly shocked patient while we search for a diagnosis.

The history is of great importance. Begin with a careful analysis of the accident. How was the patient standing when the blow was struck? What was the nature of the object which struck him? Was it sharp, rounded, or flat? Merely saying that a person was struck by an automobile or fell from a ladder is but scratching the surface. Was he struck by the bumper in the flank and thrown to one side, or was he dragged beneath the car? Did a wheel pass over him? Such details are important because very different injuries may result from each of these instances. We have the making of a real detective story here, and we must follow all clues minutely.

Consider next, the past medical history of the patient. It has been explained that pathology makes an organ especially prone to traumatic injury. Is there a possibility that the man could have had a duodenal ulcer which had ruptured due to the trauma? Has he hydrops of the gall bladder or a hydronephrotic kidney? Is he an epileptic? Has he recently had anything to suggest an intercostal neuralgia or herpes zoster? Did he ever have malaria? Is he an alcoholic (watch out for delirium tremens following any trauma)?

Supposing now, from the history, we have learned that in all probability the injured person's viscera were normal at the

time of the accident. The following might have happened:

A Pointed Blow to the Epigastrium:

1. Contusion or laceration of the liver,
2. Rupture or laceration of the gall bladder,
3. Rupture or contusion of the stomach,
4. Extraperitoneal hematoma of anterior wall.

A Deep Crush of the Epigastrium:

1. Rupture of the right lobe of the liver,
2. Complete separation of gall bladder,
3. Hematoma of omentum,
4. Contusion or rupture of pancreas,
5. Rupture or contusion of duodenum,
6. Rupture or contusion of jejunum,
7. Retroperitoneal hematoma of posterior wall,
8. Rupture or contusion of transverse colon,
9. Thrombosis of gastroepiploic vessels,
10. Thrombosis of superior mesenteric vessels,
11. Laceration of mesentery.

A Pointed Blow to the Right Flank:

1. Extraperitoneal hematoma of right wall,
2. Contusion or laceration of right kidney,
3. Rupture or laceration of gall bladder,
4. Contusion of ascending colon.

A Deep Crush of the Right Flank:

1. Fracture of the right kidney,
2. Complete separation of the gall bladder,
3. Rupture of right lobe of the liver,
4. Contusion or rupture of the ascending colon,
5. Thrombosis of colic vessels.

A Pointed Blow to the Left Flank:

1. Extraperitoneal hematoma of the left wall,
2. Contusion or laceration of left kidney,
3. Contusion or laceration of spleen,

4. Contusion of descending colon,
5. Contusion or laceration of jejunum.

A Deep Crush of the Left Flank:

1. Fracture of the left kidney,
2. Rupture of the spleen,
3. Contusion or laceration of descending colon,
4. Contusion or laceration of jejunum,
5. Contusion or laceration of ileum,
6. Thrombosis of inferior mesenteric vessels.

A Pointed Blow to the Lower Abdomen:

1. Extraperitoneal hematoma of the anterior wall,
2. Contusion or laceration of ileum,
3. Contusion or rupture of the bladder,
4. Hematoma of cord at external inguinal ring,
5. Hematoma of omentum.

A Deep Crush of the Lower Abdomen:

1. Rupture of the bladder,
2. Contusion or rupture of the ileum,
3. Retroperitoneal hematoma of posterior wall,
4. Thrombosis of inferior mesenteric vessels,
5. Laceration of the mesentery.

Tearing of the portal vein or its immediate branches, and rupture of the aorta are not listed, for although these accidents sometimes follow deep crushes of the abdomen, death in such cases is almost instantaneous. For the same reason we do not list damage of the pancreas by a dislocated vertebra.

In these cases a careful physical examination is of much more value than the laboratory tests. The examination should be most painstakingly done, and should be repeated every few hours until definite conclusions have been drawn for the conduct of the case. It is surprising how completely the physical findings will change from hour to hour. Conclusions drawn from one superficial examination are apt to be not only worthless but hazardous.

Very few routines for the examination of the abdomen approach the finesse of

Howard A. Kelly's. That which follows is an adaptation of his.

Routine Examination of an Injured Abdomen:

1. Note the general appearance of the abdominal wall. Is it fat, well nourished, or scaphoid? Are there any abrasions, contusions, or ecchymotic areas? Is there any distention?

2. If the patient is stout, lift up a fold of the wall and measure its thickness between the fingers. Visualize the fact that this much padding was interposed between the viscera and the blow.

3. Very gently examine the entire abdomen with the pads of the fingers for unduly tender spots and areas of increased resistance. What sort of tonicity has the abdominal muscles?

4. With light, penetrating pressure palpate the stomach, liver, and spleen. Note particularly any wincing by the patient during this procedure.

5. Gently palpate the entire colic area.

6. Gently palpate the umbilical area.

7. Bimanually palpate each kidney. You will need deeper pressure for this. Have the patient take a full breath, and as he expires bring the fingers of both hands together.

8. Percuss the midline of the abdomen, then the flanks, then slowly turn the patient from one side to another and percuss for shifting dullness.

9. Do not forget to examine the inguinal and femoral rings.

10. Palpate along the course of the intercostal nerves. Pinch the skin along the course of these nerves. Have the patient raise his heels from the bed and repalpate any tender areas of the abdomen (Carnett's procedure).

In order to comprehend the meaning of the symptoms and signs following abdominal injury, one must review the physiology underlying them.

Pain is the most common of the symptoms. It is due to one, and only one cause, stimulation of sensory nerve endings. Usually this stimulation is due to pressure,

but occasionally it is caused by chemical reactions of toxic materials. The most frequent cause of pressure is edema about the nerve endings, but distention, accumulation of fluids, or displacement of the viscera also cause pain by pressure upon nerve endings.

The skin of the abdomen is liberally supplied with sensory nerve endings of the intercostal, iliohypogastric, and ilio-inguinal nerves. The underlying muscles are equipped with penetrating branches of these nerves. These penetrating branches ramify the transversalis muscle and send twigs to the parietal peritoneum. On the whole, the direction of these terminal branches are toward the midline. In addition, in harmony with the developmental changes of position of the abdominal muscles, the terminal filaments are directed upward. These filaments form a plexus, give off medullated fibers terminating in end-organs in the serous and sub-serous layers, and non-medullated fibers ending in fine meshes about the blood vessels. The medullated fibers are motor and sensory; the non-medullated fibers are vasomotor. The diaphragmatic peritoneum is supplied by the phrenic nerve in addition to the intercostal and sympathetic fibers.

The parietal peritoneum, then, is supplied by cerebrospinal nerves, and is exquisitely susceptible to pain stimulation. It possesses, in addition to the sensory nerves, sympathetic fibers associated with those of the visceral peritoneum.

The visceral peritoneum possesses no pain nerve-endings whatever. It is liberally supplied with sympathetic twigs from the large abdominal plexuses which are in turn formed by the splanchnics. Stimuli such as stretching, or chemical irritation by toxins, are carried to the various sympathetic ganglia and cause reflex painful stimuli in that section of the cord from which the medullated fibers to the skin overlying the source of the stimulation spring. Also, because these medullated fibers are motor as well as sensory, the

abdominal muscles covering this area are thrown into contraction. A slightly stimulated nerve is hypersensitive. Pressure over a reflexly stimulated nerve causes wincing (tenderness), and spasm of the muscles supplied by the nerve.

We are now in a position to draw some conclusions in regard to pain, tenderness, and rigidity in the traumatized abdomen.

Pain in the abdomen after injury may mean:

1. Direct stimulation of a cutaneous or muscular nerve twig. This may result from:
 - a. Direct nerve injury, or
 - b. Pressure due to a hematoma.
2. Direct stimulation of a parietal peritoneal twig. This is usually due to a retroperitoneal hematoma, but may also indicate a beginning peritonitis, distention due to hemorrhage into the peritoneal cavity, or distention of coils of intestine by gas. A careful physical examination should differentiate such causes.
3. Reflex stimulation arising in the visceral peritoneum. This may result from:
 - a. Contusion of a viscus,
 - b. Fracture or rupture of a viscus,
 - c. Distention of the visceral peritoneum by hemorrhage beneath it,
 - d. Distention due to gas in the intestine,
 - e. Toxic stimulation from:
 - beginning peritonitis,
 - stagnation of bowel contents,
 - disintegration of a hematoma.
4. Reflex stimulation from direct trauma to a sympathetic plexus.

It will be seen that the location of the pain, especially of referred pain, is often of little help in the diagnosis because of the intricacies (or rather the eccentricities), of the reflex stimulus.

The mechanism of *tenderness* and *rigidity* has been explained. These signs are more indicative of the seat of damage than abdominal pain. Right-sided rigidity and tenderness usually mean right-sided pathol-

ogy; left-sided rigidity and tenderness usually mean left-sided pathology. But there are exceptions.

If the stimulus arises from the anterior abdominal wall or the parietal peritoneum (hematoma of the subcutaneous tissues or muscles, retroperitoneal hematoma, or localized peritonitis), the rigidity and tenderness should correspond exactly to the region of injury. If the stimulus arises from the visceral peritoneum there may be no relation at all between the location of the rigidity and tenderness and the site of injury. This fact is important to bear in mind, for many men depend upon rigidity and tenderness for indices of exploratory laparotomies. This is an unsafe practice because:

1. The conditions in which we may depend upon rigidity and tenderness for the exact location of pathology (hematoma of subcutaneous tissues and retroperitoneal hematoma), are injuries not warranting operation.

2. Localized peritonitis can be accurately diagnosed by the position of rigidity and tenderness, but in the type of injuries under discussion, localized peritonitis seldom occurs. Because the injury is due to an intense force, any perforation of a hollow organ is accompanied by a squirting out of its contents into the peritoneal cavity, and a generalized peritonitis exists from the start. There should be no difficulty in the diagnosis of generalized peritonitis, in which immediate operation is advised by all who have studied this problem.

3. Injuries to the visceral peritoneum, in which case operation is often indicated, give very unreliable evidences of rigidity and tenderness.

Vomiting usually occurs because of the jolt to the sympathetics and the shock which usually accompanies these injuries. The pathway for the vomiting reflex is from the sympathetics to their ganglia, to the splanchnics, to the phrenics, to the diaphragm. This early vomiting is quite different from that which may follow

later due to ileus or peritonitis, and is associated with other signs of shock, such as a running, weak pulse, subnormal temperature, pallor or lividity, and shallow breathing. Such vomiting is characterized by an expulsive emptying of gastric contents. As long as the stomach remains empty there is no vomiting. This vomiting is to be expected and should be explained to the family of the patient.

If the early vomiting gives way to the vomiting of reverse peristalsis much significance is to be attached to it. Instead of the expulsive emptying of stomach residue there is now a sudden welling up of large quantities of yellow or brown fluid, expelled without force. This is the vomiting of dynamic ileus, which ileus may be caused by either profound shock or spreading peritonitis. It is highly important that one should differentiate between these two causes.

Meteorism. A certain amount of distention follows all abdominal injuries. This is due to dysfunction of the sympathetics, and the condition is analagous to the postoperative ileus which follows much handling of the viscera. John B. Deaver had great respect for the abdominal sympathetics, and advised great gentleness in operative manipulation of viscera. If too industrious retraction by an assistant can cause an obstinate ileus, think how much distention a severe blow to the abdomen can cause without any definite visceral injury.

Fever. A rise in body temperature above normal frequently follows the subnormal temperature of shock. This may be caused by infection, absorption of blood by the peritoneum or subperitoneal tissues, or the absorption of toxins from distended loops of bowel. DeWan likens the fate of extravessel blood to that of a gangrenous foot. There is death and disintegration of both, with a corresponding absorption of toxic products. The gangrenous foot is visible; the gangrenous hematoma is invisible. This is an exaggerated

simile, but fever, chills, malaise, and leucocytosis occur in both conditions.

Hertzler says that absorption of blood by the peritoneum begins in four hours and should be completed in forty-eight hours. Clot formation in the peritoneal cavity is very limited. Blood outside the peritoneum is much more slowly absorbed, and may take days. Most of the soluble material is absorbed by the blood vessels. Absorption of insoluble material is by the lymphatics. Morphine, by slowing peristalsis, delays all absorption from the peritoneal cavity. Dandy and Rountree show that toxic material is absorbed with equal rapidity from any area of the peritoneum.

The septic type of fever, with a late afternoon rise and a morning drop is characteristic of all abdominal injuries, and is therefore of little diagnostic value.

Leukocytosis. As pointed out previously, a high differential count helps very little in differentiating a peritonitis from an intraperitoneal or retroperitoneal hemorrhage, but it does show definitely that there is more than "hysteria" in a restless patient who has been thought to be trivially injured. It appears quite early after injury and is evident for a prolonged period.

Urinalysis is of much value. Much whole blood in the urine of a patient with a flank injury should cause grave suspicions of kidney injury on that side. But hematuria does not mean kidney rupture, and certainly it is not by itself an indication for nephrectomy. Very slight kidney trauma will cause quantities of red blood cells to appear in the urine, and several days later the urine is normal again. One must be sure that the patient has not been passing blood in his urine *prior* to the injury. Hemoglobinuria will follow hemorrhage anywhere in the body.

After being fooled once by a ruptured gall bladder, we are always on the lookout for bile in the urine. A careful watch for acetone and diacetic acid will prevent one from attributing any vomiting of acidosis to other causes.

X-ray. Recently there has been much discussion of the value of the roentgen ray in the diagnosis of gut perforation. Fluoroscopy reveals a large gas bubble after perforation, which bubble varies with the position of the patient, and can be manipulated by pressure. This would appear quite different from a colonic gas bubble, for gas in the intestine is more or less fixed, and is manipulated with difficulty. Gas escaping from a rent in the intestine tends to form a bubble in the highest possible location, as, for example, in the dome of the diaphragm when the patient is erect. With the patient on his side, the bubble would migrate to the flank.

With a perforation, however, one should remember that there is a concomitant peritonitis, consequently adhesion formation may cause strange variations in the roentgen findings. Also, in this day of many operations, one must expect adhesions in unlooked-for places, so an abdominal scar should make one wary. Adhesion of the liver to the anterior chest wall might prevent any gas from getting into the diaphragmatic dome. Adhesions may form pockets into which the escaping gas would collect and remain, change of position or manipulation notwithstanding. Personally, we have always been timid about subjecting a badly shocked patient to an x-ray examination, because of the necessary manipulations and the moving about that is required. We would advocate this procedure only in the exceptional case.

PART II. PRACTICAL CONSIDERATIONS

GENERAL REMARKS. FREQUENCY OF THESE INJURIES. We have attempted to list the injuries which occur within the traumatized abdomen as to their frequency. No attempt has been made to arrive at percentages.

1. Shock to the celiac plexus with no organic damage.
2. Injury to the subcutaneous tissues, muscle, and intercostal nerves.

3. Hemorrhage into subcutaneous tissues.
4. Retroperitoneal hemorrhage.
5. Omental and mesenteric injuries.
6. Injury to the spleen.
7. Injury to the liver and gall bladder.
8. Injury to the kidney.
9. Injury to the pancreas.
10. Injury to the stomach.
11. Injury to the intestine.

The records of the Robert Packer Hospital tend to substantiate all of the items listed here except the first three, which have been added theoretically. Certainly very few of those receiving blows to the abdomen are seen by physicians or require any surgical treatment.

The sinister import of the whole subject is that these injuries occur when least expected.

1. **RETROPERITONEAL HEMATOMA.** Many believe that retroperitoneal hemorrhage constitutes the bulk of abdominal injuries which have symptoms sufficient to bring the patient to a physician for relief. This hemorrhage may be in the anterior, lateral, or posterior walls of the abdomen, in the mesentery or omentum, beneath the capsule of the liver, spleen, or kidney, or beneath the serosa of the stomach or intestine.

The pathology of the condition is one of continued extraperitoneal oozing from small vessels torn by the impact. Because of the flaccidity of the adjacent structures, a hematoma formed beneath the peritoneum rapidly increases in size, but eventually exerts enough pressure upon the bleeding points to establish hemostasis. Hematomas formed in this fashion vary in size from that of a split-pea to that of a large orange. It is surprising what a large hematoma can result from the tear of such small vessels.

The fate of the hematoma is an interesting one. The small hematoma is hastily absorbed with a rapid disappearance of all symptoms and nothing to mark its site except a localized deposit of hemosiderin. The larger hematoma becomes organized,

the symptoms due to its absorption are more prolonged, and its site is marked by a pearly gray, dimpled scar. Occasionally the hematoma becomes encysted because of necrosis of the central portion with dense fibrinization of the periphery. Such cysts are painless tumors, and may become quite large. Very rarely does the hematoma become infected and is replaced by an abscess.

Symptomatically, the retroperitoneal hematoma resembles its associated traumatic conditions so closely that it is often impossible to differentiate it from them. The patient shows signs of mild intra-abdominal hemorrhage. He usually vomits and complains of cramps about the umbilicus. His abdomen may or may not be rigid and distended; usually it is. There is no free blood in the peritoneal cavity, hence no shifting dullness. The blood pressure is only slightly lowered. The pulse may be quite fast but of fair volume. Usually there is a leukocytosis of about 18,000 with a neutrophilic increase. The whole abdomen may be tender, or the tenderness may be localized at any point.

All those cases giving such signs and symptoms, yet not showing definite signs of severe hemorrhage or peritonitis should be tentatively diagnosed as retroperitoneal hematoma and treated conservatively.

CASE I. J. B., B17819, male, aged fourteen. Admitted six hours after an automobile wheel had passed over his abdomen. He was unconscious for a minute or so, then felt better, and was taken home. A half hour later he vomited three times and had severe abdominal pain.

The abdomen was very tense, distended, and tender throughout. Pulse 90, temperature 96°F., white blood corpuscles 11,000, 85/15.

At operation a large retroperitoneal hematoma was found near the right kidney. A pack was inserted, leaving an end protruding from the wound for drainage.

Following the operation the boy went into severe shock and nearly died. Very stormy convalescence.

The pack was removed with gas anesthesia twelve days later. Discharged as cured a month after admission.

CASE II. P. D., B15868, male, aged thirty-seven. Admitted three hours after being knocked against a caboose railing, striking against his right loin. He was dazed but not unconscious, and lay prone for several minutes, after which he was found and carried to a bunk. Soon he felt better and walked about. An hour later he became nauseated, vomited, and had severe abdominal cramps. He felt weak and dizzy. He was admitted with intense abdominal pain. His abdomen was distinctly rigid, quite tender on the right side, and somewhat distended. Pulse 90, temperature 97°F., W.B.C. 18,300, 89/11. Two days after his admission his pulse went to 115, his temperature to 102°F., and he began to vomit again. He was very dissatisfied and wanted an operation. On conservative treatment, he soon felt better. Discharged in ten days, feeling well. No recurrence of any symptoms.

CASE III. R. D., B20909, male, aged twelve. Admitted two days after a collision with a fence post while coasting. The post struck him midway between the lower border of the costal cage and the left ilium. The blow dazed him, and he lay in the snow for a while, then felt better and walked to school. He had pain in his abdomen all that afternoon. That night he began to vomit, which continued until admission. The vomitus consisted, at first, of undigested food, but later was dark green and copious.

Abdomen slightly distended. Generalized abdominal tenderness. Some slight rigidity. No dullness in either flank. No masses felt. Temperature 101°F., pulse 110, W.B.C. 17,100, 83/17, urine negative. Diagnosis, retroperitoneal hematoma. Placed under conservative treatment. Vomiting ceased, pain disappeared, temperature came to normal. Against our advice, he was taken home in four days, and was outdoors playing three days later.

He complained constantly of vague pain in his left side. Appetite fair, bowels regular, slight nausea, no vomiting. Four weeks after leaving the hospital he noticed a swelling in his upper left abdomen. This increased in size each day. No acute pain. No vomiting. Because the tumor grew quite large the parents became frightened and brought him back to the hospital. Readmitted five weeks after the accident. Abdomen greatly distended, especially in upper left quadrant. Mass about the size of a large grapefruit felt in this area.

Percussion over the mass was dull. The tumor was tense when palpated. General condition of patient excellent. Temperature 98°r., pulse 80, w.b.c., 6800, 53/47, urine negative.

Diagnosis retroperitoneal cyst. Operation advised. Operation revealed a huge cyst containing several quarts of clear hemorrhagic fluid. The tumor lay between the folds of the gastrocolic omentum and extended backward behind the stomach. The cyst was evacuated and a rubber tube left in the cavity for drainage.

Mild convalescence. Wound healed kindly with no drainage. Discharged as cured three weeks after the operation and eight weeks after the accident.

Our retroperitoneal hematoma patients have done best when kept in bed for a week or ten days, made comfortable with codeine and ice-bags, and limited to fluids until the nausea and distention disappear entirely. They are then advised to avoid all heavy work or sudden strains for at least three weeks.

II. SPLENIC DAMAGE. By nature the spleen is the poorest protected of the abdominal organs. It is soft, non-compressible, unusually vascular, and has no real protective capsule. At the next autopsy, take a piece of fresh spleen between your fingers and see how easily it is broken. Its protection by the lower left ribs and the diaphragm is more apparent than real, for very slight trauma will, at times, cause great damage to this organ.

Crushing injuries may cause frightful trauma to the spleen, but bad jolts and the whipping action of its pedicle are responsible for most splenic damage. Whole pieces of splenic tissue may break off and lie loose in the abdominal cavity. Also, very slight injuries, such as small lacerations or contusions of the splenic surface occur, so that it is ridiculous to advocate splenectomy for all splenic injuries.

Because the spleen is so vascular, small lacerations bleed considerably at first, and a good-sized clot forms in the peritoneal cavity. It has been explained that it is this clot which, by its disintegration,

causes most of the symptoms. Operative intervention, in a case in which the spleen has stopped bleeding, can hope to accom-



FIG. 5. A fall upon icy pavement did this to a spleen.

plish nothing more than the evacuation of part of this clot. Certainly splenectomy at such a time would be crude and faulty surgery.

With any signs of severe bleeding, the abdomen should be opened at once and the bleeding controlled. Suture of splenic tears or lacerations is impracticable, hence splenectomy is definitely indicated by continued bleeding.

Many cases of secondary splenic hemorrhage are reported. We have seen several of them. These are due to a return to heavy physical work shortly after a supposed recovery from an abdominal assault. By prolonged rest and gradual assumption of labor all such accidents can be averted.

CASE IV. L. D., A45306, female, aged three. Admitted nineteen hours after being struck by the bumper of a moving automobile. She was thrown to the side of the road. She was examined in our dispensary, but her parents, thinking she was unhurt, took her home contrary to our advice. That night she grew

severely ill, and was brought back to the hospital early the next morning. She vomited frequently and had intense abdominal pain. She was pale and restless. There was a large bruise over her left flank. The abdomen was distended, and tender throughout. Rigidity, definite fluid wave, and shifting dullness. Temperature 101°F., pulse 160 and weak, w.b.c. 19,800, 45/55. Diagnosis, rupture of spleen. Operation advised. Operation twenty hours after injury. Piece of spleen found free in abdominal cavity and undergoing decomposition. Much free and clotted blood. Splenectomy. Uneventful convalescence. Complete recovery in twenty-eight days.

CASE V. L. W., B13448, female, aged ten. Admitted a half-hour after her sled had been struck by an automobile. She was unconscious for ten minutes, and was brought to the hospital in a lethargic state. She complained of severe pain and tenderness in her left upper abdomen. No definite rigidity or distention. She was restless and thirsty. During the night she vomited several times. Transfusion the next day helped her greatly. The evening of the second day brought evidence of beginning rigidity. The pain and vomiting continued. Fluids given subcutaneously and intravenously. Definite rigidity on the third day. w.b.c. 41,000, 94/6. Her general condition had now improved so that operation was possible. Ethylene anesthesia. Large quantities of free and clotted blood were found in her abdominal cavity. The spleen was torn completely in two. No other visceral injuries. Splenectomy. Closure without drainage. Discharged, feeling well, in nineteen days. It is interesting to note that this girl had blood in her urine, while no demonstrable kidney lesion was found at operation.

CASE VI. L. A., A51605, male, aged 23. Admitted twenty-four hours after having slipped on an icy pavement, falling upon a milk bottle he was carrying under his left arm. The bottle did not break. Arising, he noticed dull pain throughout his entire abdomen. He felt nauseated, but did not vomit until twenty hours later. He soon had what he called gas-pains and felt bloated. He walked home and went to bed. An enema gave him no relief. He had pain on deep breathing or moving, but none on lying still. Thinking that he had fractured a rib, he came to the hospital for

an x-ray. The x-ray of his chest was negative, but he was advised to remain for observation. There was no blood in his urine. Examination of his chest was negative. He was tender over the left upper quadrant and epigastrium. No rigidity. No shifting or flank dullness. w.b.c. 17,200, 84/16, pulse 92, temperature 98°F. The day after admission he was perfectly comfortable, with a normal pulse and temperature. Forty hours after admission he suddenly became restless, complained of air-hunger, his pulse became rapid and was soon imperceptible, and he died within an hour.

Autopsy showed a large amount of recent, free blood in the peritoneal cavity and a large, stellate fracture of the spleen. Death was due to a massive, delayed hemorrhage from the torn pedicle.

III. LIVER, BILE DUCT, AND GALLBLADDER DAMAGE. In spite of its excellent anatomic protection, the liver is frequently torn by trauma. This liver damage may vary from a small subcapsular hematoma or slight laceration to complete rupture, with separation of large pieces of the gland. The whole liver has been known to be torn from its moorings.

Severe liver injury is induced by a terrific assault upon the abdomen, consequently fracture of the liver is so frequently accompanied by other injuries, themselves so grave, that the liver injury is found by accident or at autopsy. In such cases any operative procedure is out of the question because of the poor condition of the patient. Falls down elevator shafts or from trestles, injuries by rapidly moving automobiles or trains, or crushes between two freight cars or by a truck pinning a man against the side of a building, all these are typical causes of a crushed liver. In our own cases and in most of those reported in the journals, rupture of the liver is accompanied by compound fractures, head injuries, and chest crushes.

But occasionally there occurs a glancing blow, such as that imparted by falling lumber, which misses the lower costal margin and strikes the free edge of the liver, usually the right lobe. Such a blow causes a bending of the free edge beyond

its limit of elasticity and a laceration of the liver substance results. Small liver lacerations bleed profusely at first but almost always cease in from twelve to twenty-four hours. Also, especially if a small hepatic duct be torn, bile will escape into the peritoneal cavity and a bile peritonitis develops.

We do not agree with those who speak of all injuries of the liver as "rupture of the liver," and advocate early operation for its alleviation. Such advice is confusing. Upon opening the abdomen of a patient with typical symptoms of "liver rupture," one is apt to be chagrined to find much less liver damage than had been anticipated. Puttering about a small liver laceration is bad surgery, for by the time the oozing is stopped (if at all), half the free edge of the liver is enmeshed in mattress sutures and the patient goes back to his bed a very shocked man. If a small laceration is found, it is better either to leave it alone, if it has ceased bleeding, or to place a pack against the laceration and cease activities.

Large liver rents must be closed by careful mattress suturing. Liver suturing is a real art, for the tissue is friable and very vascular. Small-caliber needles with integrally affixed twenty-day chromic sutures are the best for this work.

There is a very important point that one should not overlook in reviewing statistics concerning liver injury. As has been mentioned, it is the bad habit of many writers to speak of all liver injuries as "ruptures." Minor liver injuries frequently exist, which are only found at exploratory laparotomies or at autopsy. Some men, especially Levin, Thorlakson, Hay, and Dicks, advise laparotomy as soon after injury as the diagnosis of "visceral injury" is established. It is not fair, when abdomens are opened routinely, to diagnose small liver lacerations as "liver rupture" and attribute the certain recovery of the patient to the repair of the liver damage.

The immediate death-rate of severe liver

injury, according to Vance, is 33.3 per cent. Thirty-eight per cent of patients die within six hours. Only 28.6 per cent of his patients

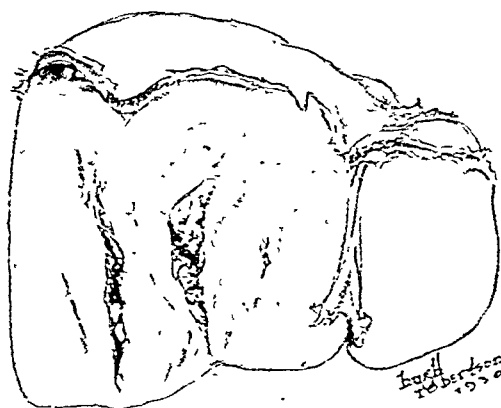


FIG. 6. Pulverization of right lobe of liver.

lived long enough for clinical observation, and of these only 10 per cent were in any shape for operation. Thus, any discussion of operation upon a severely torn liver automatically excludes the 9 out of every 10 patients, upon whom operation is impossible. Hinton is ultraconservative about severe liver injuries, and has lower mortality figures to show for his efforts than other, more radical, writers.

At the Guthrie Clinic we have never had a patient with a severe liver injury live long enough to get to the operating room. Our experience is that he is admitted in grave shock from which he never recovers. Operating upon such patients would have resulted in "autopsies in vivo," from which we shrink.

Mild jaundice and biliuria appear following most liver injuries, even the slight ones. Should the jaundice become marked or much bile appear in the urine, one should become suspicious of damage to the gall bladder or the biliary ducts. Bile peritonitis resembles septic peritonitis, but is slower and less severe. Damage of the biliary system must be corrected as soon as the patient can be put into condition to withstand an abdominal operation. Such an operation should be deliberately planned. The patient should not be rushed

to the operating room as soon as one is convinced of the nature of the injuries. Usually this damage is in the form of a tear or rupture of the gall bladder. Occasionally the entire gall bladder is torn from all attachments and lies free in the peritoneal cavity.

The usual causes of biliary system injury are falls across beams and rumble-seat trauma.

CASE VII. L. P., B17501, male, aged eleven. Forty-eight hours before his admission, L. P. fell 5 ft., while doing stunts in a barn, striking his epigastrium against a stall. Considerable abdominal pain that day. Next day he began to vomit undigested food and then clear fluid. He was unable to keep anything in his stomach, even water. His mother noticed that he was becoming distended. Enemas did no good. He was then brought to the hospital.

Pulse 120, temperature 99°F., respirations 55, W.B.C. 15,600, 91/9. Abdomen greatly distended, especially over the left epigastrium. Tenderness extended over the entire abdomen. Tympanitic except in the left lumbar region. During the night of his admission he had severe pain in the lower right thoracic region which radiated to his right shoulder. This was typical gall-bladder colic, but was not recognized as such. Respirations were painful. Mucous membranes were pale, the pulse was rapid, and he grew more distended. About this time jaundice began to be noticeable over his legs and back. Upon the finding of bile in his urine, operation was advised.

Operation ten days after admission, twelve days after the accident. A ruptured gall bladder was found; hanging by a few shreds to an uninjured liver. All other viscera found uninjured. An extensive bile peritonitis had developed. Cholecystectomy. The wound was drained. The boy made a very slow but complete recovery.

IV. PANCREATIC DAMAGE. The pancreas is more often injured than is generally supposed. This is evident from the number of patients with abdominal injuries that develop glycosuria at some time during their convalescence. The absence of the usual symptoms of pancreatitis is accounted for by the fact that the pan-

creatic damage is limited in most cases to a slight contusion of the gland.

A cross-section of the abdomen at the level of the pancreas impresses one with the excellent anatomic protection of that organ. Certainly trauma from the anterior surface of the body would have the most likelihood of damage to the pancreas, but the interposition of other tissues will dull very sharp blows, and by the time the force reaches the pancreas most of its energy is spent.

There are instances of extensive pancreatic damage from rather trivial blows. Robson and Cammidge, for example, saw a butler who died as a result of a fall against the edge of a table. The primary damage was slight, but it inaugurated a chain of events which was fatal. This process will be discussed later. Ordinarily it may be confidently expected that anterior blows will cause only mild pancreas injury from which the patient will rapidly recover.

Assaults from the flanks or back are prone to cause more severe damage, for the gland is so well protected in those directions that any injury at all presupposes a most vicious force which bone, muscle, and gland tissue are totally unable to withstand. In such cases marked symptoms of a hemorrhagic pancreatitis become manifest at once. The following was such a case, but more severe injuries completely masked the symptoms of a pancreatitis.

CASE VIII. H. L., B2066, male, aged eighteen. Fell from a railway bridge, upon his back, into 2 ft. of water. His legs were paralyzed, but he managed to crawl to the bank of the stream, where he lay for eight hours in the snow before his cries attracted attention. He was admitted in grave shock. A hematoma extended from the eleventh dorsal to the fifth lumbar spines. X-ray showed crushing of the bodies of the twelfth dorsal and first lumbar vertebrae. Decompression laminectomy considered, but not done because of the condition of the patient. Pulse on admission 70. Next day it was 120. Urine normal. The day following admission he began to cough up rusty

sputum, and complained of much pain in his left chest and upper abdomen. When first seen, the abdomen was soft and flat, and no tenderness was elicited. The next day he began to be distended, and had marked abdominal tenderness. These symptoms were attributed to the lobar pneumonia. He became nauseated, vomited large quantities of foul brown material, and died fifty-four hours after being brought to the hospital.

Autopsy. The abdomen was much distended. The stomach was dilated and the intestines ballooned with gas. No fluid or blood present in the peritoneal cavity. Kidneys, liver, and spleen uninjured. The pancreas was ruptured transversely. There was a large retroperitoneal hematoma 15 by 6 cm. overlying the rupture, and a large area of fat necrosis extending along the spine on the left side. Complete separation of the cord at the point of vertebral fracture. Left lobar pneumonia. This boy showed no glycosuria in several examined specimens.

The fatal chain of events which may follow a slight contusion of the pancreas may develop rapidly, it may spread itself over a period of days or weeks, or it may arrest itself and resolve at an early stage. Once the program is well begun, however, it is unequivocally progressive. The mechanism of this course of events is excellently described by Stern.

Extravasated blood, becoming infected, erodes the gland and accumulates until the limits of the capsule are reached, which causes excruciating pain and shock. With the rupture of the capsule there is an immediate flooding of the lesser peritoneal cavity and the retroperitoneal space along the posterior abdominal wall with highly irritative material. With this spilling of digestive ferments there is a digestion of surrounding tissues with further destruction and hemorrhage.

Rolleston described an abscess of the head of the pancreas, with fat necrosis, which was found at autopsy eighty days after a blow to the abdomen. The patient had been comfortable until a collapse which simulated intestinal obstruction, from which he rapidly succumbed.

Painless blood cysts of the pancreas

occasionally follow injuries to that organ. These owe their formation to secondary hemorrhage following a slight contusion. These hemorrhages have their origin in the substance of the pancreas or its blood supply, and are due to erosion by pancreatic ferments, especially trypsin. The bleeding may occur many days after the accident. The cysts form behind the bursa omentalis, dissect out into the gastrocolic omentum and push back beneath the stomach. They communicate always with the pancreas. Unless the cyst ruptures, there is not a drop of blood in either peritoneal cavity, or is there enough peritoneal irritation to give rise to any well marked symptoms. A glance at a longitudinal section of the abdomen, showing the peritoneal reflections of the omentum, will explain this process clearly.

Mikulicz saw a man who, eight days after being caught between two wagons, complained of pain and fullness in the epigastrium, vomited, and had dyspnea. Six days later, fourteen days after the accident, at operation, two huge cavities containing 6 qt. of red fluid were opened. These cavities were drained. A fistula developed, which drained pancreatic fluid during the four months that the patient survived the operation. At the autopsy a scar 3 mm. in diameter was found near the tail of the pancreas. This was the small area whence the destruction came.

The symptoms of pancreatic injury depend upon the pathology. In the huge majority of cases a transient glycosuria is the only clue. Since it is extremely rare that pancreatic injury exists without other visceral damage, the picture is so befogged that no clear-cut symptoms of contusion of the pancreas can be described. With hemorrhage into the gland, or leakage of pancreatic enzymes into adjacent tissues, no doubt should exist as to what is wrong. The symptoms of hemorrhagic pancreatitis, Moynihan states, are such that "no other catastrophe produces at once such unendurable agony and so profound a collapse."

The severity of the pain and the collapse is due to the proximity of the pathologic process to the solar plexus. The pain, present more or less in the epigastrium, is more marked in the lumbar portion of the back, and is not relieved by the ordinary dose of morphine. Pain is present from the time of onset until its relief by operation. It may be intermittent in type, or at times colicky, then diminishing or disappearing to return later with increased fury. Sudden relief of pain is a danger signal, for it means release of capsular tension.

The pain in the back may be mistaken for a kidney injury.

Vomiting does not occur unless there is peritoneal irritation; it is then persistent in spite of gastric lavage and restriction of fluids by mouth. Nausea, retching, and hiccough some days after an abdominal injury should make one stop, look, and listen.

A patient with pancreatitis is always motionless. He is afraid to move. He does not toss about, fold his arms across his abdomen, press against the back of a chair, and, finding no relief, walk about in agony as does the patient with gallstone colic. He is distended. Usually there is little of the rigidity or tenderness expected with such severe symptoms. The abdomen is practically never board-like; nor does the patient draw up his knees and lie upon his side as does the man with a perforated ulcer.

At the present time there are no reliable, uniform tests for determining abnormal pancreatic function. We must depend upon our senses for a diagnosis.

Treatment of the damaged pancreas depends entirely upon the underlying pathology and the condition of the patient. To state rules would be silly. In 9500 autopsies at the Pathological Institute of Leipsig, in seven and a half years, there was only one grossly visible rupture of the pancreas. Although Stern has found over 100 reported cases of rupture of the pancreas, only 28 existed without associated injuries of other viscera. Serious

damage to the pancreas, then, is a very rare occurrence.

Upon any evidence of a hemorrhagic pancreatitis, which evidence should be easily discernible, one should go bravely in through a right rectus incision, open the gastrocolic omentum in a bloodless area, and enter the omental bursa. There, beneath the parietal peritoneum, one can see anything that is amiss. Any septic material should be evacuated and drainage established. Attempts to do more will usually be fruitless. Severe bleeding may be checked by deep sutures of large gut, but tamponage is just as effective and much safer. A pancreatic fistula will probably result. These sinuses drain for prolonged periods in spite of anything one can do, after which most of them gradually obliterate themselves.

With any less evidence than that of a hemorrhagic pancreatitis, or the presence of a cyst which should be exposed and drained, the patient is best treated by prolonged rest in bed, careful high-fat diet, and sedatives. He should be kept from heavy work for two months or more, and his urine and blood watched closely for sugar.

The disturbance of sugar metabolism that follows pancreatic injury is an interesting one. Most patients with pancreatic damage have a glycosuria at some time during their convalescence. Stern's case, a woman, had as much as 308 mg. of glucose per 100 c.c. of blood and 4 per cent glucose by volume in her urine. Umber, after carefully reviewing the subject, denies that pancreatic trauma has any bearing upon the etiology of true diabetes mellitus. At any rate, the sugar gradually disappears from the urine of the majority of the injured and does not recur. One should be sure that the patient did not have a low grade diabetes prior to his accident.

V. RUPTURE OF THE STOMACH. The empty, healthy stomach cannot be materially damaged by blunt trauma. When it is distended, a blow will result in the application of hydraulic pressure to all portions

of the stomach wall. This force is directly proportionate to the energy of the blow, and is exerted in equal force in all directions. With the energy resultant from the average automobile collision, rupture of the distended stomach may take place, should the abdomen of the driver be prodded by the steering wheel, or should one of the riders be thrown against the forward edge of the rumble-seat compartment.

Frankel determined by experiments upon the stomachs of dogs, children, and adults, that the stomach is more elastic crosswise than lengthwise, and that the greater curvature is more elastic than the lesser. The least elastic portion of the stomach is near the pylorus. All objects break in their lines of least elasticity; hence most ruptures of the stomach occur near the pylorus on the lesser curvature, and the break is usually in the longitudinal axis of the organ.

Several factors are responsible for the infrequency of this catastrophe. First, the stomach is distended with food only a small part of the day. Second, most accidents occur in the rush hours of traffic which precede the evening meal. Third, the pedestrian, the most frequently injured, very rarely receives a blow to the epigastrium. When struck, he is usually hurrying home, with an empty stomach, for dinner.

Kicks by animals are especially prone to cause stomach rupture, for accidents of this nature usually happen shortly after the patient has eaten breakfast and is harnessing the animal for a day's work, or while working about stalls after the evening meal.

When the stomach bursts, gastric contents are squirted throughout the peritoneal cavity. A generalized peritonitis of both septic and chemical nature exists from the moment of injury. There is little doubt as to what is wrong, for the patient is in severe shock, the abdomen is rigid, tender, and soon enormously distended. Absence of liver dullness cannot be depended upon, for this phenomenon is elicited but occasionally.

A massive hemorrhage from the liver, spleen, or kidney, will often give much the same picture as a fulminating chemical peritonitis. With severe bleeding there is distinct air hunger and cyanosis, but, because immediate laparotomy is indicated for either hemorrhage or peritonitis, a definite diagnosis in such cases need not be made preoperatively.

There should be no question as to what to do for a ruptured stomach. The sooner the rent is closed, the better is the prognosis, but at best the outlook is a gloomy one. Here is one of the few conditions in surgery where operation must be performed regardless of the patient's condition. Without operative repair, the patient cannot possibly survive.

CASE IX. M. C., B16894, male, aged thirteen. Admitted nine hours after having been kicked in the abdomen by a horse. This occurred shortly after the boy's supper. He was dazed, but walked to the house. Soon after, he had severe abdominal pain, and vomited twice in the nine hours which preceded his admission. There was no blood in the vomitus. (Only in very rare cases does a patient with a ruptured stomach vomit blood.)

On his way to the hospital he grew very thirsty, and drank voluminous quantities of water. He walked into the hospital. The abdomen was rigid and very tender throughout. He was definitely distended. Pulse 120, w.b.c. 9200, 63/35, temperature 96°F. The urine showed a trace of sugar (pancreas damage). Operation was delayed because of his condition. In four hours he went into complete collapse, and died two hours later.

Post-mortem examination showed a tear 5 cm. in length near the pylorus, gross diffusion of undigested food throughout the peritoneal cavity, and a diffuse purulent peritonitis. Also there was extravasated blood about the head of the pancreas.

-- This boy was mortally wounded, and there is little doubt that he could not have survived an operation by more than a few hours, yet all who saw him felt that an operation might have given him an extra chance.

VI. INTESTINAL DAMAGE. Direct trau-

ma may injure the intestine in two ways. First, the force may tear open the bowel. Second, the mesentery may be torn from

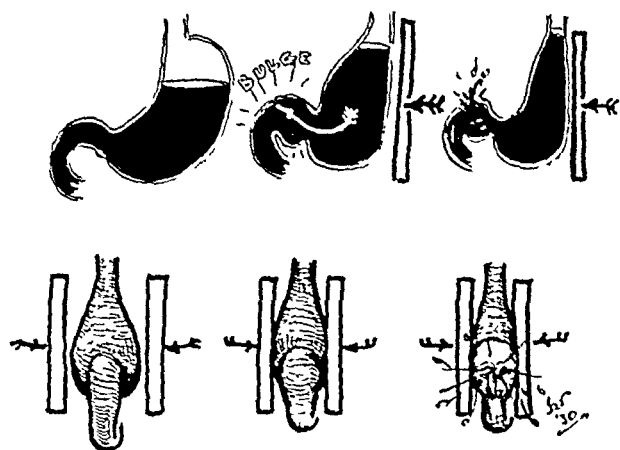


FIG. 7. Hydraulic rupture of duodenum.

the bowel. In the first case peritonitis results; in the second case hemorrhage results. If loops of the bowel are caught and ground against the vertebrae or bony pelvis, severe destruction can occur without any marked signs on the exterior of the abdomen.

The duodenum is less seldom injured than the jejunum or ileum. When it is damaged, the injury consists practically always of a transverse tear near the pylorus. The most likely explanation of this is an explosive thrust of gastric contents into the curve of the duodenum. The jejunum is most frequently torn near the duodenojejunal flexure. Only rarely is it or the ileum ruptured by hydraulic force. These structures are usually torn open by sudden forceful torsion.

Perforation of the colon due to non-penetrating trauma is so extremely rare that it is not listed in the "Index Medicus." The colon, so used to insults, escapes unscathed from the most vicious abdominal bruises.

The intestine, when torn, may spill but a few drops of its contents during the first few hours after the injury. This is because the circular muscle fibers, by their contraction, and the torn mucosa, by its extrusion, will temporarily close the breach. For this reason, even if the intestine should

be torn, one should not expect the typical set of symptoms he is accustomed to see with a perforated ulcer. The ruptured-ulcer patient is prostrated at once. Men have been known to walk about for several hours without any great distress when the jejunum or ileum had been badly torn. Later, there is no mistaking the diagnosis.

Minor injuries such as contusions or hematomas of the intestinal wall or tears of the mesentery occur more frequently than major injuries (perforations). These minor injuries give quite the same symptoms as the major ones at an early stage. Very rarely indeed is the diagnosis of rupture of the small intestine made pre-operatively, except there be a definite accompanying peritonitis.

Delayed rupture of the small intestine is by no means a surgical curiosity, for it occurs just often enough to make one respect it. It follows a contusion of the intestinal wall by several weeks or a month. The process involved is the disintegration of a subserous hematoma; the huge majority of hematomas heal kindly with no such disastrous sequela. The fact that a traumatized area may become avascular, gangrenous, and break down, either with or without infection, at a prolonged period after the injury, should ever be kept in mind.

With definite evidence of a peritonitis, operation should be delayed not a minute. In traumatic rupture of the stomach or intestine we do not feel that repair of the damage is sufficient. Usually there has been leakage of large quantities of debris into the peritoneal cavity, and we always feel happier if we establish free drainage. If there is much distention of the intestinal coils, we do a jejunostomy. All this is done with as little handling of the viscera as possible.

It is well to make the incision through the center of the contused area, so that the damaged viscus will be near at hand. Also, make the incision long enough so that the field can be visualized without too

much manipulation, for overzealous handling is fatal here.

If the rent be a small one, and the edges

the accident, a large tear was found in the mesenteric edge of the ileum. Eight inches of the ileum were resected.

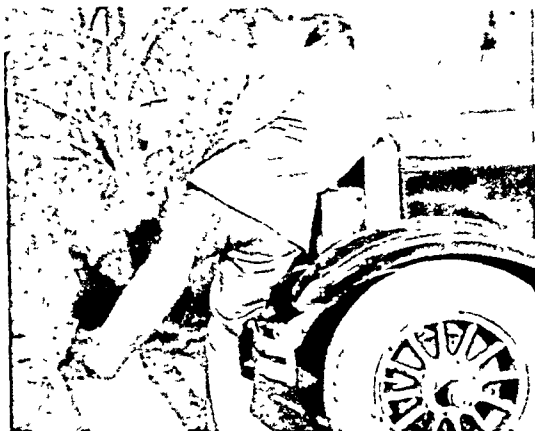


FIG. 8. Full hit. Adult.



FIG. 9. Sideswipe. Child.

FIGS. 8 and 9. Kidney trauma of automobile accident.

clean, simple suture with intestinal catgut or linen will suffice. If the tear be quite long and there is a possibility of constriction of the lumen resulting from its simple closure, try closing it in the manner of Mikulicz's pyloroplasty, that is, in the opposite axis to the tear. If the edges of the rent are macerated or eroded, it is better to resect the damaged gut than to attempt a repair which might break down. End-to-end anastomosis is preferred.

CASE X. R. W., B21773, male, aged fifty-seven. Admitted twenty hours after his injury. He and another man were pulling upon a branch of a tree that was frozen into the ground. The branch broke and struck the patient in the left abdomen with sufficient force to knock him down. He got up without assistance and walked a quarter of a mile to his home. On his way there he had cramp-like pains in his abdomen. He vomited twice. A physician saw him six hours after the injury, gave him some morphine, and departed. The next day the pain and vomiting were worse, and he was brought in to the hospital. Upon his arrival his pulse was 106, temperature 101°F., and his white cell count was 17,600, 92/8. He was much distended, exquisitely tender over the entire abdomen, and the abdominal wall was very rigid. Upon operation four hours after his admission and twenty-four hours after

The man made an uneventful recovery and was discharged a month later.

VII. KIDNEY DAMAGE. The kidney lies embedded in a pad of fat in the laterodorsal abdominal wall. It is quite well protected from violence from behind, and to a certain extent from directly in front, but it is easily injured by a blow to the flank.

That a certain amount of shock occurs following kidney concussion without definite gland injury, is amply demonstrated by the effect of "kidney punches" in the prize ring. Jostling of the renal sympathetic plexus is responsible. Consider also the excruciating pain of a Dietl's crisis and the prostration brought about by distention of the renal pelvis or the passage of a stone. Kidney injuries are very painful things. Severe pain does not mean severe damage.

By far the most frequent result of a blow to the kidney is a subcapsular hematoma. Such a hematoma results from the bursting of one or several of the small subcapsular vessels, and the cortex need not be damaged at all. Since the ureter acts as a safety-vent, rupture of the kidney by hydraulic force cannot occur in a healthy individual. Fragmentation of the gland can, and does occur following severe crushes; the cracks usually do not extend through to the pelvis,

and only in very rare cases is there actual separation of kidney tissue. The most severe injury possible is a tear of the renal

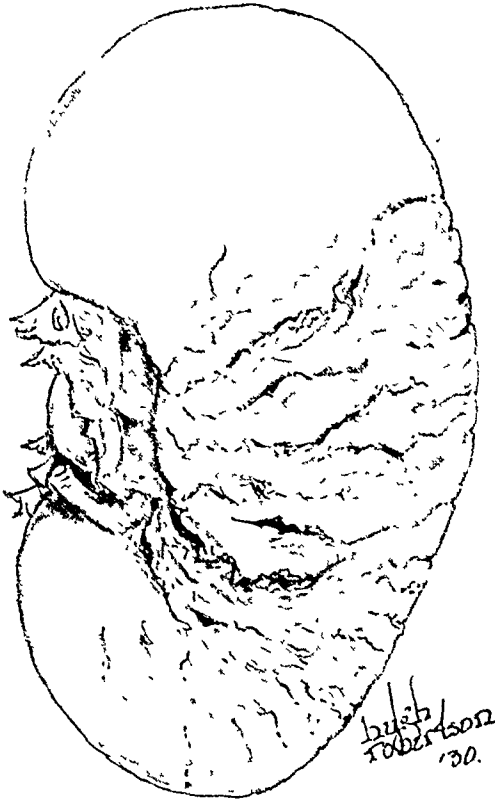


FIG. 10. Fracture of kidney.

vessels due to the whipping action of the force and the recoil of the elastic tissues. In such a case, a massive hemorrhage results, and yet the kidney itself is structurally intact. Why some men speak of such a variety of injuries as "rupture of the kidney" is a puzzle.

Kidney damage due to trauma is ordinarily quite easy to diagnose. The shock and attendant pain have already been spoken of. Frank hematuria is an almost constant finding, the amount of blood in the urine depending upon the location and severity of the kidney damage. An injury to the renal pelvis, or the calices, will bring down large quantities of bright blood. It has been proved that simple concussion of the kidney, without any gross damage, is sufficient to provoke a definite hematuria.

Flank trauma, plus hematuria, is not

unequivocal evidence of gross kidney injury necessitating operative repair. Such opinions are unfortunately current in medical journals. Case v, page 407, is an example of hematuria without gross kidney damage. Complete avascularization of the kidney, due to a torn pedicle, may occur without any bleeding into the ureter. Too much weight should not be placed upon the presence or absence of hematuria following trauma.

Tears of the renal vein are more frequent than breakage of the renal artery. The walls of all large veins are easily torn. Pressure in the renal vein is quite low. Since the bleeding from this vein is into confined spaces, it is soon controlled by the pressure of its hematoma. The renal artery, unless it be rendered brittle by arteriosclerosis, is very seldom torn open. The pressure in the renal artery is sufficient to dissect into the tissues, and a fatal massive hemorrhage usually results.

Bleeding from kidney injuries is always retroperitoneal, yet men are occasionally seen percussing the abdomen for shifting dullness, suspecting "kidney rupture," and fully expecting to find signs of fluid in the abdominal cavity.

The extent to which a damaged kidney will repair itself is amazing. The subcapsular hematoma which causes so much pain and distress disappears in from four to six days with all its symptoms including the hematuria. Contusions and fractures of the kidney substance heal in from ten to twenty days with remarkably little diminution of kidney function.

Those who see the greatest number of traumatized kidneys, and the urologists to whose lot the eventual treatment of these patients fall, are the loudest criers against radical kidney surgery. The damaged kidney may have to be removed later, but nephrectomy should only be done when the patient is in good physical condition and after the surgeon has assured himself that the opposite kidney will bear the extra work to be thrown upon it. Most traumatized kidneys heal without surgical

intervention. Pyelography and cystoscopy are best reserved until the patient has been hospitalized for several weeks. Then, if indications point to it, treatment (irrigations, etc.), may be begun.

The best guide in the care of a patient with a damaged kidney is the quality and rate of the pulse and the trend of his blood pressure. As long as these continue in the right direction, one had better be satisfied with rest, care, and opiates. If, however, changes in the pulse and blood pressure indicate continued bleeding, operation is definitely indicated.

Because of the uncertainty of what one might encounter, complete anesthesia is preferable to regional blocking. Having the patient in the proper position on the table is a great help. The incision should be long enough so that one can see what he is about. As much of the kidney as possible should be saved. Leaving one-tenth of a kidney is giving the man that much extra cortex, which might later be the deciding factor in a crisis. Barney says that he has seen kidneys, which he at first thought should have been removed, function perfectly when examined at a later date. After having accomplished what is intended, one should not fall into a philosophical frame of mind and begin to "fix things."

Nephrectomy should be reserved for those cases in which the renal vein or artery is torn, and then only if the bleeding vessels can be securely clamped and tied. Faced with a badly shocked patient and voluminous bleeding from a retracted vessel, one should not attempt to remove the kidney, but tampon the wound with gauze and get the patient back to bed.

Operating upon a patient who is progressing nicely, with an intention of "repairing the damage," is courting disaster. Opening the confined quarters and shelling out a clot which is undergoing organization, has on many occasions been the signal for a fatal hemorrhage. Such a case follows.

CASE XI. X., male, twenty, seen in another city. This boy was riding in the rumble-seat of a car which was sideswiped by another machine. The collision was not a severe one and no one appeared hurt. After the usual taking of license numbers and names both machines departed in their separate directions.

The patient had noticed that he had gotten quite a hard jolt in the right lumbar region from the arm-rest of the rumble-seat, but had no severe pain. Several hours later he became nauseated, vomited, complained of sharp pain in his right side, and fainted. He was taken to a nearby hospital.

Urinalysis showed bright red blood and clots. twenty hours after his admission he had become comfortable, his pulse had come down to normal, and he was in quite fair physical condition. Diagnosis easily made of lacerated kidney.

Operation done at once proved the correctness of the diagnosis. The kidney was torn completely in two. The torn renal vessels were not found, for the patient bled to death on the table and the operation was not completed. Much clotted blood in the wound showed that the kidney had ceased bleeding spontaneously prior to operation.

A typical example of a lacerated kidney which healed spontaneously with physiological rest and no operative interference follows.

CASE XII. N. C., B19294, male, aged twenty. While playing football, this boy was kicked in the right lumbar region. He had considerable pain in the right flank which radiated down towards the penis. He felt so sick that he left the game. Next day he passed small blood clots and bright red blood in his urine. He was admitted two days after his injury. Marked rigidity over the entire abdomen. Slight tenderness over the left, marked tenderness over the right upper abdomen. Increased dullness in upper right quadrant. He did not vomit. Temperature 100°F., pulse 100, W.B.C. 15,200, 82/8. Albumin, pus, and blood in urine for two weeks with occasional days when he passed normal urine. Diagnosis apparent, lacerated kidney. Treated expectantly. Ice to abdomen, opiates, rest. In eight days he was symptom free. Two weeks after admission he felt well, urine was normal, and he was about in a wheel chair. Discharged twenty-one days

after the accident with clear urine and no symptoms of impaired renal function. One month later he was seen again. He experienced no return of the discomfort or pain. No tenderness over kidney elicited by deep palpation. Urine as follows:

1008, acid, no albumin, no sugar, no blood or pus cells.

VIII. CONCLUSIONS. We can summarize our experience with non-penetrating wounds of the abdomen as follows:

1. Conservatism has proved to be the best policy. If one is to err in his handling of an intra-abdominal injury, it is safer in a group of cases to err on the side of doing too little.
2. No one can be dogmatic concerning the treatment of these injuries. Each case presents a different problem, and should be dealt with

accordingly. Some patients should be operated upon immediately; others should never be subjected to operation.

3. Differential diagnosis is difficult and often impossible. A clear conception of the modus operandi of the injury and the force involved will make the diagnosis much easier.

4. At the Guthrie Clinic and the Robert Packer Hospital we operate only upon those patients showing evidence of uncontrolled hemorrhage or peritonitis.

5. Any trauma involving the abdomen calls for critical study, and bears careful watching for a prolonged period of time.

6. Automobile manufacturers should be made to realize the dangers of the present rumble-seat. Attempts should be made to so design the rear compartment that this danger is minimized.

TABLES

The Forces of Moving Bodies

TABLE I

TABLE OF VELOCITIES IN FEET PER SECOND

Miles per Hour	Feet per Second
5	7.33
10	14.66
20	29.33
30	44.00
40	58.66
50	73.33
60	88.00
70	102.66
80	117.33
90	132.00
100	146.66
110	161.33
120	176.00
130	190.66
140	205.33
150	220.00
160	234.66
170	249.33
180	264.00
190	278.66
200	293.33
210	308.00
220	322.66
230	337.33
240	352.00
250	366.66
260	381.33
270	396.00
280	410.66
290	425.33
300	440.00

TABLE II

GRAVITY FORMULAS

Velocity of a falling body in feet per second,
32.16 X seconds.
Distance of fall during any second,
16.08 X one less than twice the second.
Total distance of fall in any given time,
16.08 X square of seconds.
Changing feet per second to miles per hour,
MPH: $\frac{\text{ft. per second}}{1.465}$

TABLE III

VELOCITY OF FALLING BODIES

(Air resistance discounted. Figures approximate only.)
End of 1st second body falls 32.16 feet per second, or
22 miles per hour.
End of 2nd second body falls 64.32 feet per second, or
44 miles per hour.
End of 3rd second body falls 96.48 feet per second, or
66 miles per hour.
End of 4th second body falls 128.64 feet per second, or
88 miles per hour.
End of 5th second body falls 160.80 feet per second, or
110 miles per hour.
End of 6th second body falls 192.96 feet per second, or
132 miles per hour.
End of 7th second body falls 225.12 feet per second, or
154 miles per hour.
End of 8th second body falls 257.28 feet per second, or
176 miles per hour.
End of 9th second body falls 289.44 feet per second, or
198 miles per hour.
End of 10th second body falls 321.60 feet per second, or
220 miles per hour.

TABLE IV

DISTANCE OF FALL PER SECOND OF FREELY FALLING BODIES

1st second, body falls 16.08 feet.
2nd second, body falls 48.24 feet, and has fallen 64.32 feet.
3rd second, body falls 80.40 feet, and has fallen 144.72 feet.
4th second, body falls 112.56 feet, and has fallen 257.28 feet.
5th second, body falls 144.72 feet, and has fallen 402.00 feet.
6th second, body falls 176.88 feet, and has fallen 578.88 feet.
7th second, body falls 209.04 feet, and has fallen 787.92 feet.
8th second, body falls 241.20 feet, and has fallen 1029.12 feet.
9th second, body falls 273.36 feet, and has fallen 1302.48 feet.
10th second, body falls 305.52 feet, and has fallen 1608.00 feet.

In ten seconds, 1608.00 feet.

TABLE V

FORCE OF IMPACT (FORCE OF TRAUMA)

Estimation of force. The force of impact will depend upon:

1. *The point of application.*
The area upon which the force is exerted.
2. *The direction of the blow.*
The line along which the force tends to move the point of application.
3. *The magnitude of the force.*
A value compared to a standard. The relative rate at which the force would produce motion were the point of application freely movable.

TABLE VI

TABLE OF EQUIVALENT VALUES

To gain some practical idea of the amount of force to which the abdominal wall is subjected in a collision or a fall, compare the force of impact with that produced by the fall of a 200 lb. sandbag upon an abdomen from various heights.

Such equivalent values are of course crude, but they have been arrived at by careful mathematical computation. The figures are given in round numbers for simplicity.

Example One

A girl weighing 125 lb. is driving a Packard roadster at 40 miles per hour. The car swerves and hits a concrete culvert. She is thrown against the steering wheel.

In this case the weight of the car can be entirely discounted, for the force of impact of the girl's abdomen against the steering wheel would be equal to the impact of an object weighing 125 lb., moving through space at 40 miles per hour, against a stationary body.

In the example given, the force of impact to the girl's abdomen would be equivalent to that produced by the fall of a 200 lb. sandbag from the height of 42 feet.

Example Two

A boy of 160 lb. is riding in the rumble-seat of a Ford roadster. The car is moving at 45 miles per hour. The car is crowded off the road and hits a large tree. The boy is thrown against the front partition of the rear compartment.

This accident is of the same type as that of example one, in that the force of the impact is that of a body of 160 lb. moving through space at 45 miles per hour. In spite of the fact that he is riding in a much lighter car than the girl in example one, he receives a much harder blow. This boy received a blow to his upper abdomen equal in force to the impact of a 200 lb. sandbag dropped from the height of 52.5 feet.

Example Three

A boy of 60 lb. was playing circus in a barn. He fell from the trapeze for a distance of 15 feet and struck his abdomen against an oat-bin.

He received a blow equivalent to the impact of a 200 lb. sandbag dropped upon his abdomen from a height of 4.45 feet. This was sufficient to rupture his gall bladder.

Example Four

A man weighing 150 lb. slipped upon an icy pavement and fell 3 feet upon a milk bottle he was carrying under his arm, the bottle striking him in the left flank.

He received a blow equivalent to the impact of a 200 lb. sandbag dropped upon him from a height of 2.6 feet. This was sufficient to crush his spleen, as was evidenced at autopsy.

TABLE VII

FORMULAS USED FOR DETERMINATION OF EQUIVALENT FORCES

All forces are compared to the fall of a 200 lb. sandbag.

1. *Determination of the force of the collision.*

$$\text{Force: } \frac{\text{Mass} \times \text{Velocity}^2}{2} \quad (\text{Use miles per hour.})$$

2. *Velocity in MPH of sandbag's fall to equal this force.*

$$\text{Velocity}^2: \frac{\text{Force}}{100}$$

3. *Reduction of miles per hour to feet per second.*

$$\begin{aligned} 1 \text{ MPH} &= 1.465 \text{ FPS} \\ \text{FPS} &= 1.465 \times \text{MPH} \end{aligned}$$

4. *Time required by sandbag's unimpeded fall to reach this velocity.*

$$\text{Time: } \frac{\text{Velocity}}{32.16}$$

5. *Distance fall of sandbag to equal force of collision.*

$$\text{Distance: } 16.08 \times \text{Time}^2.$$

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[For Remainder of References see p. 453.]

ROENTGENOGRAPHIC MEASUREMENT OF PELVIC AND CEPHALIC DIAMETERS*

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NEW YORK

THE presentation of an accurate method of pelvimetry needs no justification. The many methods that have been proposed in the past and that continue to appear in the literature bear witness to the fact that most of the maneuvers of physical examination practiced in estimating the size of the pelvic inlet are inexact and unreliable, as proved by roentgenological study.

The one of most value today was described by William Smellie nearly two hundred years ago, the method of determining the diagonal conjugate diameter. Those who have used roentgenography agree that it is far more accurate than any of the procedures heretofore employed.

But even the diagonal conjugate is uncertain, because in women with a high and thick symphysis pubis the sacral promontory sometimes cannot be reached. Moreover, in many nulliparous women, the rigidity and sensitiveness of the soft parts are such as to require an anesthetic for proper examination. When it comes to estimating the true conjugate from the diagonal according to the estimated height and thickness of the symphysis, a decided element of inaccuracy may be introduced.

For these reasons I believe that a roentgenogram should be obtained in every case of pregnancy in a primipara where there is suspicion of a disproportion in the pelvis and also in multiparae with histories of previous difficult deliveries.

In various articles I¹ have pointed out the importance of roentgenology in gynecological diagnosis. And in the June, 1931, number of *THE AMERICAN JOURNAL OF SURGERY* I attempted to show the service that roentgenographical diagnosis can render in obstetrics, in diagnosing pregnancy

in obscure cases and determining presentation, position, multiple pregnancies, and monstrosities.

In the present article, I propose to deal with measurements of the pelvis and fetal head as a means of determining the relative size of passage and passenger. In other words, I wish to discuss and make clearer roentgenographical pelvimetry and cephalometry.

To the general practitioner or physician who does an occasional delivery, a roentgenographical examination in the later months of pregnancy would very often furnish an excellent guide as to the right course. It would inform him as to whether the case is within his experience, whether it should be a home delivery, or whether it is to be a hospital case. It is true that in labor other factors besides the relative size of pelvis and fetus should be taken into consideration, such as, for example, the strength of the musculature of the uterus and abdominal wall and the distensibility of the cervix. Still, one may get a reasonable idea from a knowledge of the relative size of the fetal and pelvic diameters as to what influence they will bear upon the other factors in the case.

The experience of many reliable observers here and abroad indicates that the very brief exposures required for roentgenography for diagnostic purposes are entirely harmless even in the last months of pregnancy. The information given by such roentgenographical films is invaluable in prenatal care and I believe that one can ill afford to omit such an important diagnostic aid.

Without going into the literature of the earlier roentgenographic methods for estimating the pelvic measurements, it may

* Submitted for publication May 29, 1931.

be said that their failure was due to a distortion in size and shape of the pelvic shadows owing to unsatisfactory technique as regards the position of the patient, the mode of directing the ray, and the lack of a measuring scale that corresponded accurately to the degree of distortion of the pelvic image.

With improved methods these obstacles have been overcome, so that roentgenological pelvimetry now offers a practical and exceedingly exact means of determining the pelvic diameters.

SUPERIOR STRAIT MENSURATION

Pelvic mensuration has been employed and described by Thoms² for a number of years. His was the pioneer work. The measurements obtained by this method have been carefully checked up and have been shown to be accurate and reliable.

In my own work, I have followed Thoms' technique in principle. However, I have modified the procedure in some details, because in my experience the method as I have employed it enables one to obtain roentgenograms of unusual clarity and to determine the pelvic diameters with considerable ease.

This technique will be described subsequently in the present article.

Brief mention should be made of various modifications of Thoms' method. The most important is that suggested by Roberts,³ who employs a different method of calculation. Thoms uses a series of notched lead plates, while Roberts arrives at his results by simple proportion:

Anteroposterior diameter on film: true conjugate:: tube distance from film: tube distance from pelvic inlet.

For example, if the diameter on the film measures 12.5 cm., the target-film distance is 90 cm., and the pelvic plane lies 18 cm. above the sensitive film, then the proportion is expressed as follows:

$$\begin{aligned} 12.5 : x :: 90 : 72 \\ 90x &= 900 \\ x &= 10 \end{aligned}$$

Ten centimeters represent the true conjugate diameter with these factors.

More recently (April, 1931), Hypher⁴ has described another application of Roberts' procedure as follows: The patient sits on a Potter-Bucky diaphragm with her legs dangling over the edge, and with her back inclined at such an angle that the plane of the true pelvic brim is parallel to the film. The tube is centered over the estimated midpoint between the promontory of the sacrum and the symphysis pubis. The perpendicular distances between the focus of the tube and the film, and the spine of the fifth lumbar vertebra and the film, are measured. The required internal diameters are measured on the roentgenogram and multiplied by the fraction:

$$\frac{(\text{Tube distance from film}) - (\text{Distance of fifth lumbar spine})}{(\text{Tube distance from film})}$$

The result gives the actual diameter with a possible error not exceeding 3 mm.

Other workers who have made important contributions to the literature on measurement of the female pelvis by means of roentgenography include Heublein,⁵ Grier,⁶ Martius,⁷ Guthmann,⁸ Schaeffer and Witte,⁹ Collisi,¹⁰ Granzow,¹¹ von Schubert,¹² Bickenbach,¹³ and Reinberger and Schreier.¹⁴ An ingenious instrument for determining the pelvic measurements, recently devised by J. B. Jacobs,¹⁵ may prove of value though it does not involve the use of x-rays. This instrument, called the inclinometer, consists essentially of a modified pair of calipers with a weighted pendulum attached to the anterior surface. With it one may measure and secure a graphic picture of the female pelvis.

AUTHOR'S PROCEDURE FOR ROENTGEN PELVIMETRY

As previously stated, I have patterned my procedure after Thoms' pioneer method, introducing however, certain modifications which in my experience are conducive to clear films and simple calculation.

To insure proper position of the patient

on the table, two external landmarks must be identified: namely, (1) the upper and anterior border of the symphysis pubis and

fifth lumbar vertebra, immediately above which the adhesive tab should be placed.

Thoms places the patient on the table

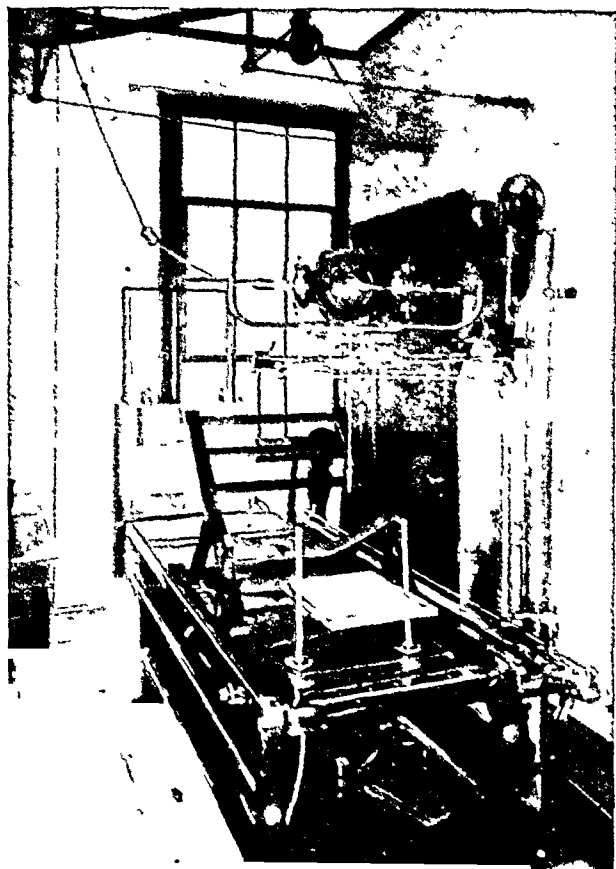


FIG. 1. Apparatus for roentgen pelvimetry after Thoms' method, showing supporting frame and adjustable measuring scale. (*Am. J. Roentgenol.*)

(2) the interspace between the fourth and fifth lumbar vertebrae. An imaginary line between these points traverses the anteroposterior diameter of the inlet.

A small circular adhesive tab is used to mark the space between the fourth and fifth lumbar vertebrae. This is shown in Figure 2, which also outlines Michaëlis' rhomboid, a diamond-shaped depression noted in well-formed women. Michaëlis' rhomboid is conspicuous in the Capitoline Venus and other beautiful statues of female figures. It is formed by the dimples overlying the posterior superior spines of the ilia, the lines formed by the gluteal muscles, and the groove at the end of the spine.

The upper angle of Michaëlis' rhomboid corresponds to the spinous process of the



FIG. 2. Anteroposterior diameter of pelvic inlet is determined by imaginary line extending from upper and anterior border of symphysis pubis to interspace between fourth and fifth lumbar vertebrae. A small adhesive tab is placed in latter location for identification. This can be located in well-formed women immediately above apex of Michaëlis' rhomboid. Insert shows relation of this tab to bony structures.

in a semi-recumbent position. I prefer a sitting position with a back-rest supporting the head and back, and the lower portion of the back arched so as to bring the imaginary line between the anterior superior border of the symphysis pubis and the identifying adhesive tab on the back, i.e., the diameter of the pelvic inlet, on a horizontal plane. This makes the plane of the pelvic inlet parallel with the sensitive film, which is incorporated with the Potter-Bucky diaphragm into the top of the table. By bracing her feet against the foot-rest and her hands against the table, the patient is enabled to maintain the required position with considerable comfort. This is shown in Figure 3. The thighs are parallel to the top

of the table and the sensitive film, while the legs are allowed to hang over the edge.

With a pair of calipers the distance

behind the symphysis. In this position the rays pass through the center of the inlet.

I have found that clearer films may be



FIG. 3. Position of patient on table for roentgen pelvimetry. Lower spine is arched so as to bring anteroposterior diameter of pelvic inlet, measured from anterior superior border of symphysis to identifying adhesive tab on back, on horizontal plane, that is parallel with sensitive film in Potter-Bucky diaphragm. Calipers measure distance from adhesive tab to sensitive film, and plumb-bob locates distance of symphysis pubis. Insert is a sagittal section showing relation of various parts to anteroposterior diameter of inlet.

from the identifying adhesive tab to the sensitive film is measured, placing a marker on the table overlying the film. As a rule, the distance from the adhesive tab to the top of the table is 10 to 13 cm.; from the top of the table to the film, 5 cm. Hence the distance from tab to film varies from 15 to 18 cm.

A plumb-bob suspended from a support near the tube touches the symphysis pubis and thus locates the distance of the anterior limit of the plane of the pelvic inlet from the film. The tube is placed so that the central rays are 90 cm. from the target to the film and also about 5 cm.

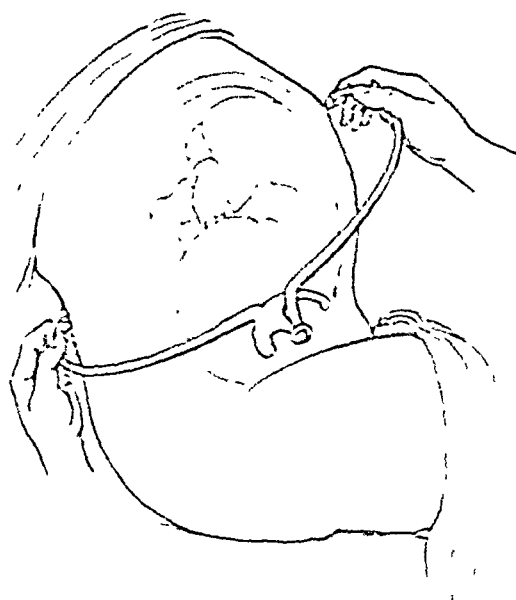


FIG. 4. Measuring degree of abdominal distention as factor in determining duration of exposure. Measurement is made at level of umbilicus. Obese patients with polyhydramnios require longer period of exposure.

obtained by considering the amount of liquor amnii and the thickness of the abdominal wall as elements determining the time exposure factor. An obese woman with polyhydramnios requires a longer exposure than a thin woman with a normal amount of amniotic fluid. Figure 4 shows measurement of the anteroposterior diameter of the abdomen at the level of the umbilicus. The time of exposure should vary from twenty to thirty-five seconds, according to the estimated thickness of tissue and fluid that must be traversed by the x-rays.

The plumb-line and bob are removed and a 14 X 17 cassette is placed into the Potter-Bucky diaphragm so that the patient's hips are crosswise on the film. The exposure is then made with fast screens and speed films according to the following technique:

Distance	90 cm.
K.V.	85
M.A.	25
Time	20-35 seconds

It is of course apparent that the diameters recorded on the sensitive film are not the actual diameters of the pelvic

plumb-line. Then a second exposure is made on the same film, using the same technique except that the time is two

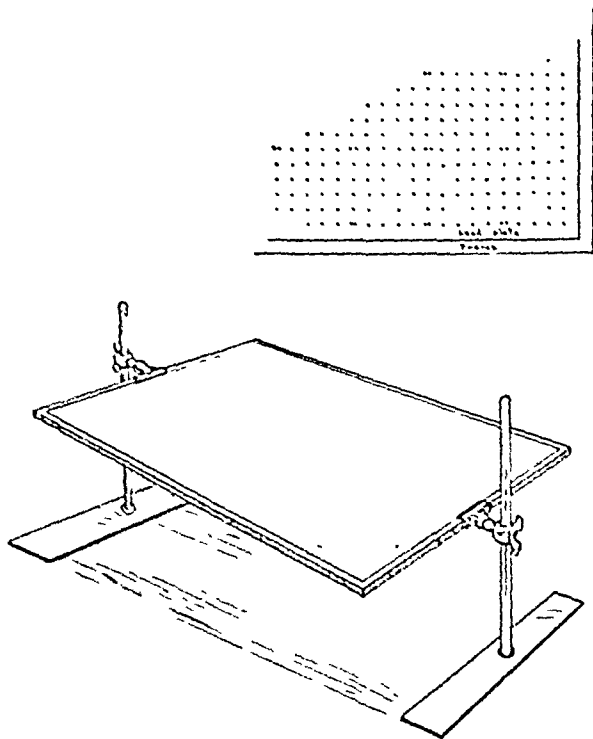


FIG. 5. Lead plate on thin wooden board, with adjustable support. Insert shows section of plate to emphasize perforations, which are exactly 1 cm. apart. By double exposure, first of pelvic inlet and then of lead plate made to occupy exactly same plane, latter becomes accurate measuring scale on exposed film.

inlet. They are enlarged in proportion to the distance of the film from the pelvic inlet. However, this enlargement is uniform and calculable, because the plane of the pelvic inlet and the sensitive film are parallel.

The measurement is made very simply by removing the patient and substituting a lead plate $\frac{1}{32}$ inch thick with holes exactly 1 cm. apart in the exact plane formerly occupied by the pelvic inlet. In order to place the lead plate on the same plane occupied by the pelvic inlet during exposure, place the posterior part of the plate over the marker on the table which designates the identifying adhesive tab and measure the same distance with calipers. The anterior part of the lead plate is so placed that the location is the same as that formerly occupied by the symphysis pubis. This is measured by the

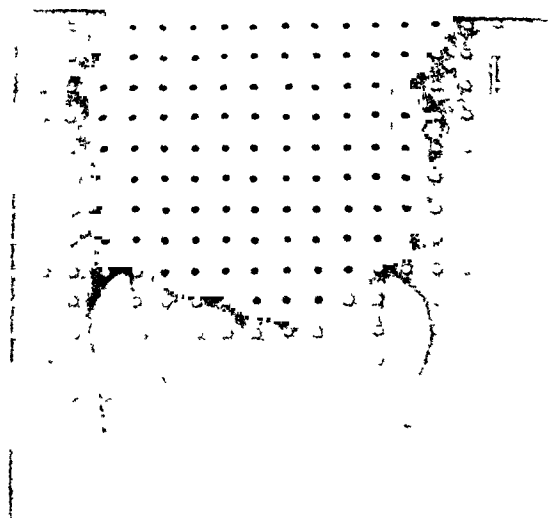


FIG. 6. Pelvic roentgenogram with exposure of lead plate superimposed. Diameters of inlet are measured by counting number of spaces between perforations, each of which represents 1 cm.

seconds. Hence the pelvic diameters and the holes in the lead plate are distorted in exactly the same proportion, and the diameters can be read in centimeters by simply counting the number of spaces between perforations they occupy, regardless of actual measurements on the film.

In Figure 5 note the lead plate on a thin wooden board and an adjustable support. The insert shows a section of this plate, with the perforations exactly 1 cm. apart.

Figure 6 shows the roentgenogram of the pelvic inlet with that of the lead plate superimposed. The pelvic diameters are measured by counting the spaces between perforations, each of which represents 1 cm.

This is shown clearly in Figure 7. While the perforations are actually more than 1 cm. apart on the film, because they have been distorted in projection, they have been distorted to exactly the same extent as the pelvic inlet. Hence the true conjugate or the transverse diameter may be measured by simply counting the spaces between the perforations.

Figure 8 is a roentgenogram of the pelvic inlet taken without use of the perforated lead plate. If the factors are known,

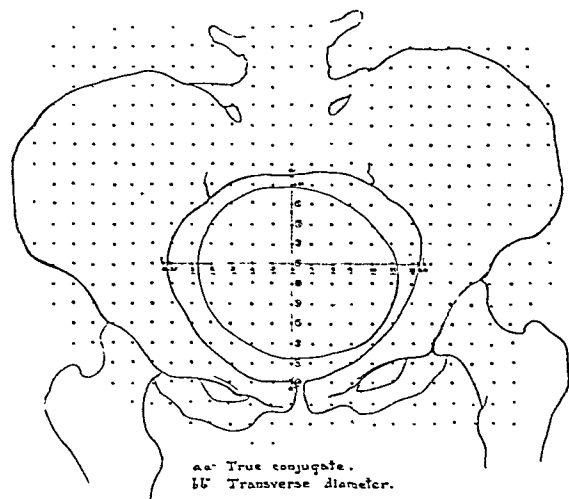


FIG. 7. How true conjugate and transverse diameter may be measured by simply counting spaces between perforations and expressing in centimeters. Although these spaces are actually more than 1 cm. apart on film, they have been distorted to exactly same extent as pelvic inlet.

the pelvic diameters can be calculated from such a roentgenogram by geometrical methods.

A simple calculation of the true pelvic diameters without use of the perforated lead plate may be made as follows:

Multiply the actual measurements on the film by the following fraction:

$$\frac{(\text{Tube distance from film}) - (\text{adhesive tab distance from film})}{(\text{Tube distance from film})}$$

For example, let us assume that the target is 90 cm. from the sensitive film and the identifying adhesive tab 18 cm.; also, that by actual measurement the anteroposterior diameter of the inlet is 12.5 cm. on the film.

Our multiplication factor becomes $\frac{90 - 18}{90}$ or $\frac{72}{90}$. Multiplying the actual measurement on the film, 12.5 cm., by this fraction to correct error due to distortion, we obtain the product of 10 cm., representing the conjugata vera.

LATERAL ROENTGEN PELVIMETRY

Thoms² also stresses the value of lateral

roentgenograms of the pelvis. He points out that by lateral roentgenograms the size and contour of the anterior surface of



FIG. 8. Roentgenogram of pelvic inlet without use of perforated lead plate. From known factors diameters can be calculated according to method described in text.

the sacrum may be viewed. This is important in the recognition of sacral abnormalities, especially those of rachitis. In addition the relation of the presenting part to the birth canal may be studied at term, an especially valuable procedure in cases in which non-descent of the fetal head is present and disproportion is suspected.

The patient is placed laterally in the position used when the external conjugate diameter is measured. One acetabulum must accurately superimpose the other, and this is accomplished by having the legs perfectly straight and the nates in the same vertical plane. By means of a pelvimeter in position for measuring the external conjugate, that is, with one end on the superior border of the symphysis and the other against the identifying adhesive tab, a midpoint is reached between the ends of the pelvimeter. The tube or target is centered by means of a plumb-line over this point, at a distance 75 cm. from the film. The current used is 20 ma. and the exposure varies from twenty to forty seconds, depending upon the size of the patient. Duplitzed super-speed films, a double screen with Bucky diaphragm, and a medium focus Coolidge tube are used.

Following the exposure, the patient is removed from her position, the film and tube being left in place. The perforated

and the posterior surface of the symphysis are viewed. A somewhat widely spaced dotted line appears through the center

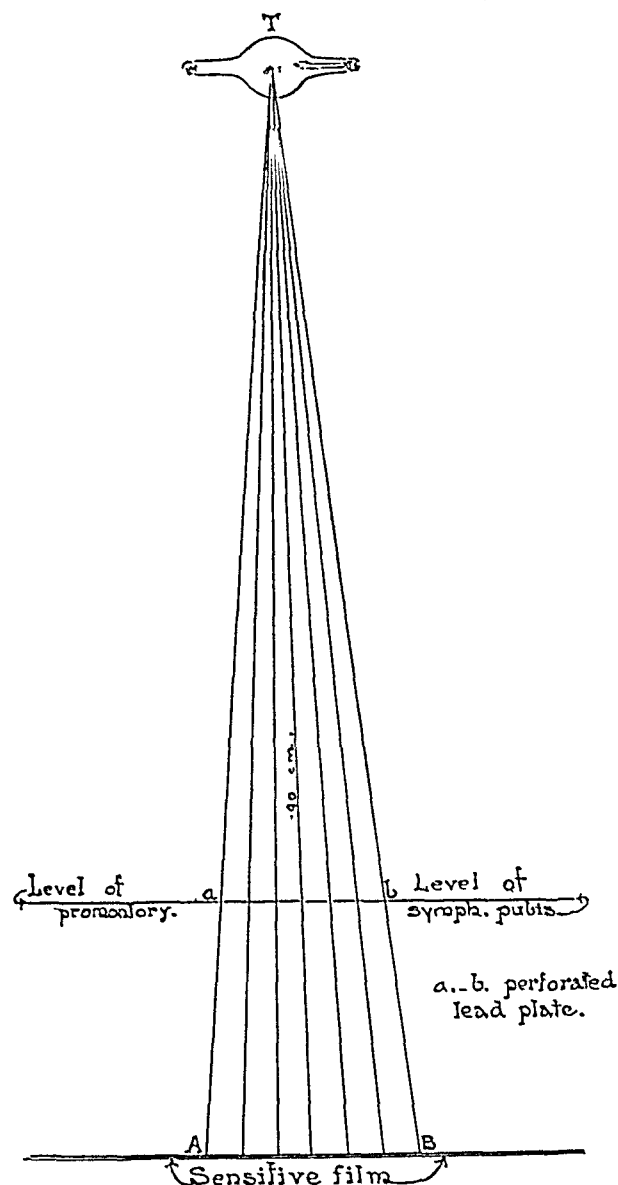


FIG. 9. How true conjugate, a-b, can be calculated from known factors. This calculation can be made by employing various geometrical theorems, but most simply by employing multiplication fraction described in text. A-B represents actual measurement of diameter on film. a-b is true conjugate diameter, plane of which is also occupied by perforated lead plate when latter is used.

lead sheet, with small holes 1 cm. apart, is then placed in the same plane as that of the anteroposterior diameter of the superior strait and a flash exposure made on the same film.

On development of the film, the promontory and anterior surface of the sacrum

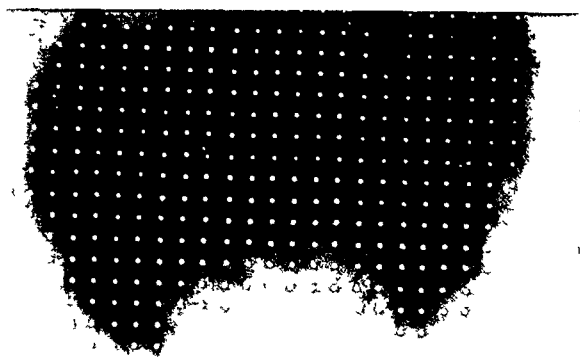


FIG. 10. Cephalogram. See Fig. 11 for explanation.

of the film. The spaces between each of the dots represent 1 cm. on the plane through which the anteroposterior diameter of the superior strait passes. This technique is simply the adaptation of the Thoms superior strait pelvimetry to lateral pelvic roentgenograms, and the principle here involved is the measurement of the conjugata vera by lateral roentgenograms.

FETAL CEPHALOMETRY

Fetal cephalography in utero is, of course, highly important in estimating relative disproportion between the fetus and the pelvic outlet. The procedure described by Thoms, who has made an exhaustive study of the subject, is essentially an adaptation of his method of roentgen pelvimetry. It is a procedure for estimating the occipito-frontal diameter in utero and securing a profile of the cranium in its true proportions.

The procedure I employ is as follows:

The patient is placed on the table in the recumbent position. The occiput and sinciput of the fetal head are located by palpation and measured through the abdominal wall with the pelvimeter. Markers are placed on the abdominal wall at

points corresponding to the extremities of the occipito-frontal diameter.

The central x-rays are passed through a

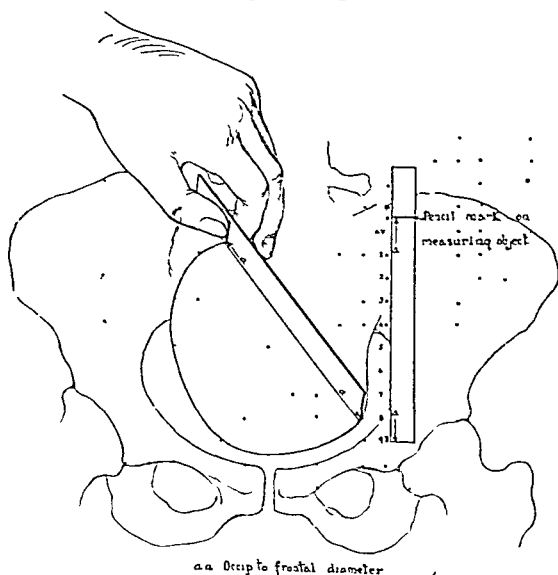


FIG. 11. Measuring occipito-frontal diameter from cephalogram. Take length of occipito-frontal diameter on film with pencil or unruled marker. Turn this measuring object vertically and count number of spaces between perforations it occupies. This represents diameter in centimeters.

point midway between the two markers and at a distance of 90 cm. from the film. A 14 X 17 film in cassette is then placed into the Potter-Bucky diaphragm pan lengthwise and the exposure made according to the following technique:

Distance	90 cm.
K.V	85
M.A	25
Time	7-10 seconds, using fast screens and superspeed films.

The distance from the target of the tube to the point marked on the abdomen for the center of the occipito-frontal plane is measured by use of the plumb-line and recorded.

The patient is taken off the table and the lead sheet with perforations exactly 1 cm. apart placed on the same plane as that formerly occupied by the fetal head. This is accomplished by bringing the plate up to the plumb-line at a fixed distance from the target of the tube. A second

exposure is then made on the same film, using the same technique as before but with an exposure time of two seconds.

Figure 10 shows the cephalogram with the shadow of the perforated lead plate superimposed. Figure 11 shows a simple method of measuring the occipito-frontal diameter directly from the cephalogram. With a pencil or unruled marker measure the diameter on the roentgenogram. Ignore the actual length in centimeters, as the diameter has been distorted in projection. Turn the marker in a vertical direction and measure the length it occupies in terms of spaces between perforations it occupies on the film. Count the number of these spaces. They represent the length of the occipito-frontal diameter in centimeters, because both the fetal head and the perforated lead plate have been equally distorted in projection.

DETERMINATION OF FETAL MATURITY

Quite recently, Thoms has called attention to the value of fetal cephalography in determining the degree of maturity of the fetus in utero. Hitherto methods employed to determine the age of the fetus in utero have been crude and inaccurate, the most dependable being that of palpating the fetus through the abdominal wall, which is obviously unreliable.

The method which Thoms² proposes is based on the method of cephalography by which the occipito-frontal diameter is obtained. A statistical study of a relatively large number (446) of newborn infants was made to determine the relationship of the occipito-frontal diameter to fetal length and body weight, and to demonstrate that a knowledge of this diameter gives a practical index to fetal maturity. In this group of 446 infants, 369 measured 45 cm. or over from crown to heel. Of these 369 infants, 337, or 91.5 per cent, had an occipito-frontal diameter of 10.5 cm. or more. It therefore appears that in a given instance, an occipito-frontal diameter of 10.5 cm. would be evidence of an accompanying crown-heel

length of 45 cm. or more. An effort was then made to determine the relation of body weight to occipito-frontal diameter. Only infants weighing under 3000 gm. were included and those under 2500 gm. were regarded as premature. Of 453 infants studied, 327 weighed over 2500 gm. In 312, or 95.4 per cent, the occipito-frontal diameter was 10.5 cm. or more. Of 126 infants weighing less than 2500 gm., 86, or 68.2 per cent, had an occipito-frontal diameter of 10.5 cm. or under. It would therefore appear in instances in which the diameter is over 10.5 cm., a body weight of over 2500 gm. may be expected. The evidence from these figures indicates that in a given instance an occipito-frontal diameter of over 10.5 cm. will be accompanied by a crown-heel length of over 45 cm., and a body weight of over 2500 gm. Hence the occipito-frontal diameter in utero affords a means of determining intrauterine fetal maturity.

STEREOROENTGEN PELVIMETRY

Roentgenopelvmetry by means of a stereoroentgenometer is described by Johnson (1929).¹⁶ The stereoroentgenometer is a mechanical device for determining the solid dimensions of objects from stereoscopic roentgenograms. A view box establishes the plane of the roentgenograms and provides illumination. Flexible wires, with automatically adjustable length and a means of terminal fixation, represent the x-rays. Adjustable pointers fix in space the relative positions of the various unknown points. A special marker adapted to the x-ray apparatus casts a shadow on the roentgenograms which is of assistance in

their exact superimposition and also in the establishment of their position on the view box. In pelvimetry the internal diameters of the bony pelvis, as well as the essential diameters of the fetal head, may be determined accurately. In determining the dimensions of the pelvis and fetal head, the diameters of the bony pelvis ordinarily given in textbooks are used. In the inlet two additional measurements have been employed, called the right and left conjugates. These diameters extend from the right and left sacroiliac synchondroses to the symphysis pubis, and are used as an additional check on the anteroposterior diameter of the inlet. The angle of the plane of the inlet is also taken; with the patient in the supine position, the average is about 40° with the horizontal.

SUMMARY

Clinical methods of determining the diameters of the maternal pelvis and fetal head, while of practical value as approximate measurements, leave much to be desired from the standpoint of accuracy. By means of roentgenographical pelvimetry, the size of the passages and the passenger may be determined with great precision. In difficult cases these exact measurements may be of much importance. Various methods by which they may be obtained roentgenographically are described.

I wish to express my gratitude to Dr. Arthur S. Unger, Director of the Department of Radiology at Sydenham Hospital, and to Miss Florence Wyble, head technician, for their valuable help, unfailing courtesy and cooperation in doing this work.

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[For Remainder of References see p. 448.]

PUERPERAL INVERSION OF THE UTERUS

GANGRENOUS UTERUS. ABDOMINAL PANHYSTERECTOMY. RECOVERY*

LOUIS E. PHANEUF, M.D., F.A.C.S.

BOSTON

IN 1926,¹ I reviewed the literature of inversion of the uterus and reported a case of chronic inversion treated by the Spinelli operation. In May, 1929,² I published a second paper entitled Puerperal Inversion of the Uterus and reported 2 additional cases, making a total of 3 cases which I had personally treated. My fourth case was seen in November, 1930, and forms the basis of this report.

REPORT OF CASE

History: Mrs. L. P., a white married woman, thirty years of age, born in Massachusetts, was admitted to the Gynecological and Obstetrical Service of the Carney Hospital on February 5, 1931. On February 2, 1931, she had entered an out of town hospital where she had been delivered normally of a female child, by her family physician, fifteen minutes after admission. Her membranes had ruptured on January 31, but labor had not started until February 2. The placenta did not deliver itself readily and the patient thought that the doctor tried to remove it manually. The uterus was inverted and a local consultant attempted to replace it without success. She was given salt solution by hypodermoclysis in the thighs. The next day, February 3, she felt weak and had to be catheterized frequently. During the forenoon of February 5, she was etherized and the consultant made a second attempt to replace the uterus by vaginal manipulations. This second attempt also resulted in failure. She was then sent to my Service, by ambulance, having to cover a distance of thirty miles.

The family history showed that her father, mother, brothers and sisters were all living and well. There were no deaths and no chronic diseases in the family. She had had measles, mumps and pertussis in early childhood;

otherwise she had always been well. Her menstruation was established at the age of fourteen; the periods were regular, of the twenty-eight day type, lasted three days, were never accompanied by pain and no clots were passed. The last period had occurred on April 26, 1930. She had been married five years; her husband was living and well. She had three children, the oldest was three years and the youngest three days old. Her first labor was terminated instrumentally and was followed by a normal puerperium; her second labor was normal but there had been some difficulty with the placental stage; her third and present labor was normal and was followed by inversion of the uterus. There were no miscarriages or stillbirths.

Examination: The patient was pale, in a state of moderate shock, but suffering no pain. Her temperature was 101°F., (38.3°C.), pulse 128 and respirations 20. The head, neck, heart and lungs revealed no abnormalities. The abdominal walls were adipose and relaxed, otherwise nothing remarkable was found on abdominal examination. The extremities and reflexes were normal.

Local Examination: The vulva was edematous and ecchymotic; it had a bluish-black appearance, the perineum showed a recent laceration extending to the sphincter ani but not through it. There was a small amount of vaginal discharge and a very foul odor from a gangrenous inverted uterus. The patient, after the usual preparation, was taken to the operating room.

Diagnosis: Puerperal inversion of the uterus. Gangrenous uterus.

Operation: Transfusion, spinal anesthesia. Panhysterectomy, double salpingo-oophorectomy, drainage. Transfusion.

I saw the patient at 3:30 P.M. and she was in the operating room at 4 P.M. She was given a transfusion of 600 c.c. of citrated blood, her husband acting as the donor. This improved her condition materially. It was decided to operate abdominally because of the edema

¹ Phaneuf, L. E. Inversion of the uterus. *Am. J. Obst. & Gynec.*, 11: 171-180, 1926.

² Phaneuf, L. E. Puerperal inversion of the uterus. *Surg. Gynec. Obst.*, 48: 709-711, 1929.

* Submitted for publication April 18, 1931.

and ecchymosis of the vulva and vagina. Spinal anesthesia was administered, using 150 mg. of sterile novocaine crystals dissolved in 3 c.c. of spinal fluid, slowly injecting the mixture. The anesthesia was hard of induction and an extra long needle was necessary to obtain the spinal fluid, the usual needles having failed. The deep Trendelenburg position was used. The abdomen was opened by a median suprapubic incision extending from the symphysis to the umbilicus. The intestines were well walled off from the pelvis by 2 three-yard wicks of gauze. The bladder was found to be full and the operation was suspended while the patient was catheterized. On examination, the crater of the inversion presented and the tubes and ovaries were drawn into it. The ring was about 4 cm. in circumference. The infundibulopelvic ligaments were tied and cut, the posterior surface of the ring was picked up by two large vulsella and traction made upward. The ring was incised posteriorly, opening the vagina; the posterior wall of the uterus was then incised until this organ could be reinverted. After reinversion the uterus was wrapped in a sterile towel and the pelvis further protected by another sterile towel. The round ligaments were cut between clamps, the bladder was freely separated from the uterus and vagina and the uterine and vaginal vessels were cut between clamps. The vessels of each side were ligated with No. 2 chromic catgut and the vagina was cut in a circular fashion so as to meet the posterior opening already made, thus removing the gangrenous uterus and adnexa. A one-yard strip of iodoform gauze was placed in the vagina, one end being allowed to come out in the peritoneal cavity. The anterior and posterior leaves of the broad ligaments were approximated with interrupted catgut sutures, covering over all raw areas but leaving a central opening for drainage. The table was placed in the horizontal position, the towel and walling-off strips were removed and the abdominal wall was closed in layers. There had been practically no bleeding and the patient had stood the operation well. A second blood transfusion of 600 c.c. of citrated blood was administered, a brother-in-law acting as the donor. She was returned to her bed in good condition, her pulse being full and 120 in rate.

Convalescence: February 6, 1931, the temperature was 101.4°F. (38.5°C.), pulse 120,

respirations 24. The general condition was satisfactory, she was voiding urine normally. February 8, the iodoform wick was removed, the bladder and the bowels were functioning normally and the patient was bright and cheerful. February 12, the temperature rose to 102°F., (38.8°C.), the pulse to 130 and the respirations to 28; she seemed comfortable. February 14, the stay sutures were removed; a large quantity of foul pus was evacuated from the incision, leaving two draining sinuses. The incision was irrigated twice daily with warm chlorinated soda solution. February 17, the temperature, pulse and respirations were normal; there was but a small amount of drainage; the irrigations were discontinued. February 23, the small sinuses in the incision were almost closed; the patient was allowed out of bed and felt well.

Laboratory Examinations: The urine was examined on February 10, and February 14. It was negative except for the slightest possible trace of albumin and clumps of pus in the sediment.

Blood Examinations: Feb. 5, 1931, on admission R.B.C. 2,140,000, Hb. 38 per cent. Sahli. Feb. 6, 1931, R.B.C. 2,070,000, Hb. 53 per cent. Sahli. Feb. 10, 1931, R.B.C. 3,700,000, Hb. 60 per cent. Sahli. Feb. 24, 1931, R.B.C. 4,170,000, Hb. 68 per cent. Sahli.

Discharge Note: February 24, the abdominal incision was healed except for two small granulating sinuses. The vaginal examination showed the vaginal vault to be well healed and high in the pelvis; there was no sign of prolapse of the bladder or rectum; there were no masses or areas of tenderness in the pelvis. She was discharged cured on the nineteenth post-operative day.

Pathological Report: The following report was received from Dr. Frank B. Mallory, who examined the specimen. "The blood sinuses are filled with clots, which probably account for the adherence of the placenta, since there is no evidence, histologically, of the lesion characteristic of placenta accreta."

Subsequent Examination: April 6, 1931, the abdominal incision was well healed; there was no induration and no tenderness. Vaginal examination showed a healed second degree laceration of the perineum; there was no cystocele and no rectocele; the vaginal vault was well healed and held high in the pelvis;

there was no bulging on straining; the patient felt well and had resumed her household duties.

Comment: Puerperal inversion of the uterus is a rare condition, the predisposing causes of which are uterine inertia, pressure on the fundus from above and traction on the cord from below. Shock is the leading symptom and when this occurs after the third stage of labor, uterine inversion should always be borne in mind. In acute cases the uterus should be reinverted, manually, when possible, as soon as the condition is discovered. In cases in which this is not possible, laparotomy and reposition by taxis seem to give the best results. When a gangrenous uterus is discovered such as the one reported here, a

hysterectomy becomes necessary. This may be done by the vaginal or the abdominal route. I am inclined to think, from our experience, that an abdominal hysterectomy is simpler to perform when there is marked ecchymosis and edema of the vagina from previous attempts at reposition. Chronic inversion is well treated by the vaginal route, anterior colpohysterotomy (Spinelli operation) when the uterus can be saved and by vaginal hysterectomy when the opposite obtains. The shock should be combated by blood transfusions before attempting the operative procedures. The obstetric future of a woman who has had a Spinelli operation should be that of one delivered by a previous classical cesarean section.



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* Continued from p. 394.

IS THE BLOOD FLOW IN VARICOSE VEINS REVERSED?

RADIOGRAPHIC AND CLINICAL OBSERVATIONS*

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ACCORDING to the acknowledged authorities beginning with Trendelenburg, and including Magnus, Jentzer, and McPheeters, there is a reversed flow in the superficial veins in which the valves are incompetent or insufficient. The Trendelenburg Law, which embodies this opinion, is generally regarded to be true. Although I have made an exhaustive review of the literature, I have been unable to find a contradictory assertion to this law. The results of experiments conducted by me are directly opposed to this accepted version. They not only disprove the reversed flow where the valves are insufficient, but they also throw considerable doubt upon the actual function of the valves in determining the direction of the flow.

The work recently reported by me, the results of which indicate that the direction of flow in the superficial venous system is toward the heart, was performed with the patients in the horizontal position. It appeared logical to me that the position of the patient might have influenced the proximal flow of the iodized oil. With this in view, the following experiments were performed with the patients in the standing position.¹

CASE 1. Figure 1 presents a uniformly dilated, saccular, tortuously varicose great saphenous vein of the right leg, extending from the mid-thigh to the mid-calf. The vein branches considerably in the calf, presenting many smaller saccular varicosities. The dark oval discoloration on the inner mid-calf plays

no part in the discussion, since it is an old gunshot scar. The positive phase of the Trendelenburg test alone is present.

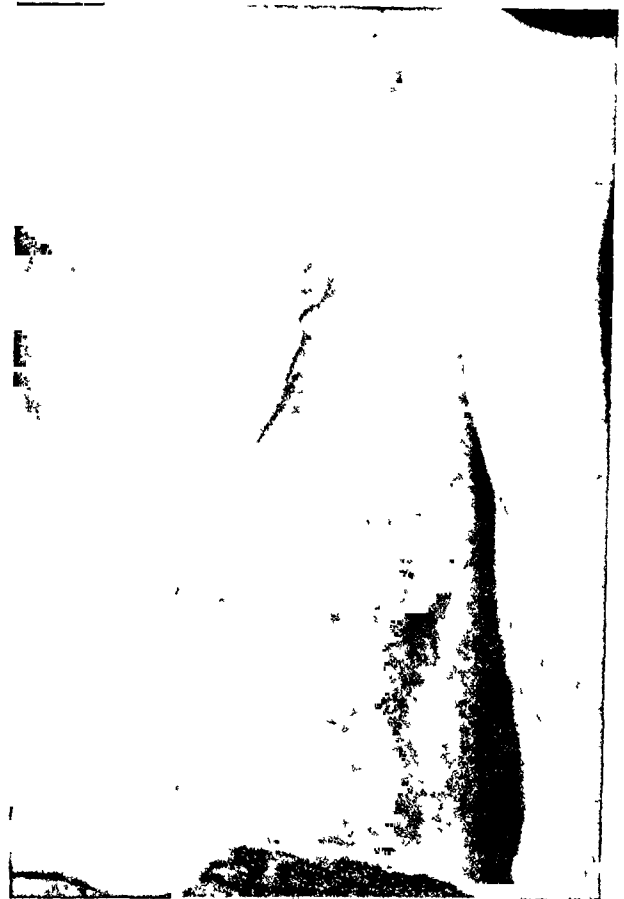


FIG. 1. Case 1. Varicose veins of right leg with positive phase Trendelenburg.

With the patient standing, 3 c.c. of iodized oil were injected into the upper end of the varicose vein. Care was taken to direct the needle downward, thus eliminating the possibility of forcibly injecting the solution towards the heart. An x-ray was immediately taken, the syringe being held in position, with my thumb on the head of the plunger. In Figure 2, it is apparent that some of the oil dropped to the level of torsion in the vein. Yet quite a bit of the iodized solution ascended along the saphenous, as is proved by the deeper shading

¹ It is quite important to note that the patients were placed in front of an upright x-ray diaphragm before any injection was resorted to. In this way roentgenograms could be taken without the patient's moving at all. This procedure was intentionally planned, so that any muscle action in moving the leg would play no part here in influencing the direction of the flow.

* Submitted for publication May 25, 1931.

of the vein above the needle here than is noted in Figure 3. It is evident that the solution has both ascended and descended. The patient

the oil, as a result of which I made inquiries with respect to the comparative weights of the blood and the oil employed. Accord-



FIG. 2, Case 1. Iodized oil ascending and descending in saphenous vein.

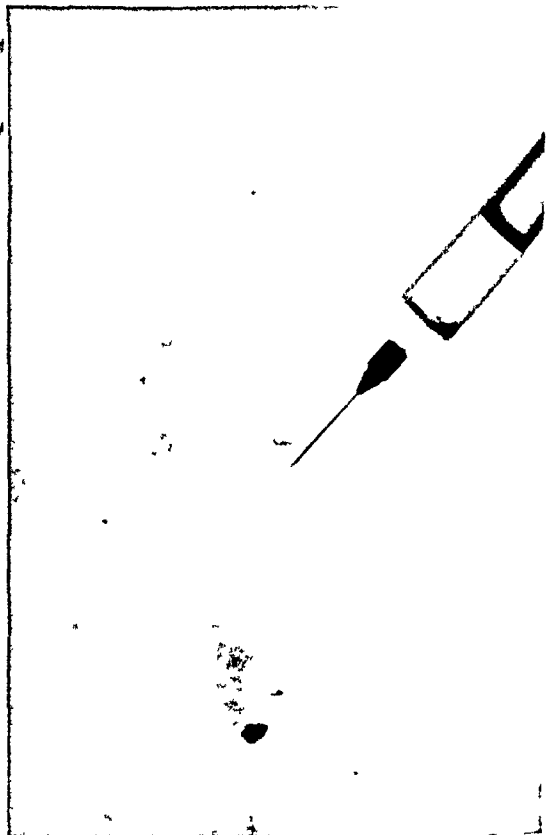


FIG. 3, Case 1. Most of oil has disappeared, due to its further descent.

was standing perfectly quietly during the entire procedure. Pressure on the plunger of the syringe was then removed, and immediately the plunger was forced back by the flow of blood. Another x-ray was then taken, and Figure 3 presents the findings. The iodized oil has practically all vanished from the area visualized. The vein above the needle has greatly diminished in density, and one can still see a portion of the oil descending in the main trunk of the saphenous. Figure 4 definitely proves that most of the iodized oil has descended into the veins of the calf.

It is evident in this case that apparently the flow of blood is in the main reversed. At least inspection of the roentgenograms would lead one to believe this. It occurred to me, however, that gravity might have played an important part in the descent of

ing to Mathews, the specific gravity of blood plasma varies from 1.0237 to 1.0276 at 25°. The specific gravity of the red corpuscles (Abderhalden) is 1.088. Therefore, the average specific gravity of whole blood is 1.0578. In contrast, the specific gravity of the iodized oil uniformly used is 1.350, a difference of 0.30 or almost a third heavier than the blood. Even if the direction of flow were not reversed, would not the heavier oil have descended? Indeed, one can readily imagine the centripetal force there must have been present in the blood stream to carry some of the heavy oil upward, as it did.

CASE II. Figures 5 and 6 present a greatly enlarged, tortuous, saccular, internal saphenous, extending from the upper inner thigh

down to the upper inner calf. Below this, the vein branches considerably into smaller saccular varicosities. A double phase Trendelenburg

oil can be seen. It is apparent, then, that the oil did not drop below the level of the penetrating vein at the inner aspect of the knee.



FIG. 4, Case 1. Descended oil scattered through veins of calf.

is present here, indicating that the valves in the saphenous and one or more communicating veins are incompetent. The large distended varix on the inner aspect of the knee, as presented in Figure 5, is the penetrating vein, the valves of which are incompetent.

The same x-ray technique was employed here as before, the patient standing quietly throughout. Figure 7 clearly indicates the oil ascending in the vein and also descending to the loop below. Figure 8 shows the loss of density above the needle noted in the previous x-ray, and further descent of the oil. In Figure 9 one sees the oil descending further. Figure 10 visualizes the varicosities fairly well, but no



FIG. 5.

FIG. 6.

FIG. 5, Case 11. Varicose veins of left leg with double phase Trendelenburg. Note large penetrating vein on inner aspect of knee.

FIG. 6, Case 11. Same case. Posterior view.

One will also note that the iodized oil remained entirely in the superficial system of veins. In this case, as in the first, the heavy oil was employed. There is no doubt that some of the oil passed upward, evidently with the blood stream, and I wondered whether all of it would not have followed, had the specific gravity of both blood and oil coincided.

Undoubtedly, any conclusions derived from these 2 cases cannot be accepted as accurate. In order, therefore, to determine the true direction of the blood stream with reference to the Trendelenburg test, it seemed imperative that I employ an iodized oil with specific gravity the same as that of the blood. Since this is quite impossible in every case, I had prepared a quantity of iodized oil with specific gravity of 1.0578, the average specific gravity of blood in all individuals. In an attempt further to interpret more accurately the results I might obtain, I determined to measure the specific gravity of the venous blood in all cases studied. The method employed was that of Hammerschlag. In comparing the specific gravities of the bloods obtained with that of the oil, I found a variation of only 0.001 to 0.02. This is negligible when we contrast the specific gravity of the blood with that of the heavy oil originally employed.

Before proceeding with the cases in which the new oil was used, I will review the interpretation of the Trendelenburg Law. In his

not interrupted by any valvular occlusion, and the fluid content of which follows chiefly the law of gravitation in its movement.



FIG. 7, Case 11. Ascent and descent of oil in saphenous.



FIG. 8, Case 11. Loss of density above needle, and further descent of oil.

original article, Trendelenburg describes what is termed the positive phase Trendelenburg, in which the valves of the superficial saphenous vein are incompetent, but says nothing of a negative or double phase Trendelenburg so commonly attributed to him. His interpretation of a positive phase is translated as follows:

As soon, therefore, as the valves of the trunk of the saphenous vein have become insufficient, no valvular occlusion takes place any longer from the varices of the leg upward to the right heart. The vena cava, the iliac vein, and the uppermost portion of the femoral vein and the saphenous vein with its branches form a single, communicating tubal system which is

The blood, which under ordinary conditions fills the region of the varicose saphenous vein, therefore originates only in a small measure from the capillaries. Most of it has regurgitated from the iliac vein.

In addition to the Trendelenburg Law, it has been accepted that in cases of negative or double phase, where the valves in the communicating veins are also incompetent, the flow is from the deep system through the communicating vein into the superficial system and up to the heart, or centripetal. In my recent article I also accepted the double phase interpretation described, since the oil did travel upward. I have since discovered that this is not

always the case, as can be seen in the following roentgenograms.

The technique employed was similar to

inner malleolus. The specific gravity is 1.037. The Trendelenburg test presents the positive phase only.



FIG. 9, Case 11. Iodized oil descending to level of knee.



FIG. 10, Case 11. Shadowy outline of veins in calf, but no oil present.

that in the first 2 cases, the patients, however, standing before an upright fluoroscope with which x-rays could also be taken. Fluoroscopic observations were first made and then a roentgenogram or permanent record obtained. This procedure allowed me more accurate observations on the activity of the iodized oil during and after the injection, as well as the effect of inspiration, expiration, coughing, and straining upon the direction of flow. The patients stood perfectly quiet throughout the procedure.

CASE III. Figure 11 presents moderately enlarged saccular varicosities extending from the upper third of the right calf down to the

With the needle directed downward, 2 c.c. of the iodized oil (specific gravity 1.057) were injected into the vein indicated. Before the injection was even completed, I could observe, fluoroscopically, the globules of oil rising in the vein. Not one globule descended below the level of the needle. Deep inspiration brought the ascent to a halt and the oil began to descend. Natural expiration had no effect upon its flow. Forced expiration caused the oil to descend, as did straining. With the patient breathing naturally now, the oil ascended through the saphenous vein into the femoral and up into the pelvis where it could not be followed. A second injection was now attempted in order to obtain a roentgenogram of so interesting a demonstration. Unfortunately,

however, my needle slipped out of the vein and some of the oil entered the perivenous tissue. No reaction followed for several weeks,

gravity is 1.048. Before resorting to the x-ray to ascertain the direction of the blood stream, I thought it plausible that a clinical test might



FIG. 11, Case III. Varicose veins of right leg with positive phase Trendelenburg. Blood specific gravity is 1.037.



FIG. 12, Case III. Iodized oil ascending in saphenous to level of mid-thigh. Note shadows around needle due to previous perivenous injection.

and the veins were felt to be as soft as originally. The injection was then repeated, and again the solution ascended, as is noted in Figure 12. Only .05 c.c. of the iodized oil was injected. Three distinct globules can be seen ascending above the level of the knee joint. A few similar globules can be noticed in the internal saphenous at about the mid-thigh. The iodized oil of the previous injection can be seen in the subcutaneous tissue.*

CASE IV. Figure 13 presents an enlarged saccular, tortuous internal saphenous vein extending from the upper inner left thigh to the inner middle left calf. The positive phase Trendelenburg is alone present, and the specific

* It may be stated that the injection of a viscid oil through a small gauge needle requires tremendous force, during which procedure the needle may easily slip out of the vein.

determine the source of blood to the varicose veins. With this in view, the following procedure was employed. The patient was placed in the recumbent position with the leg elevated. When the veins emptied, a tourniquet was applied above the level of the uppermost varicosity. The patient was then allowed to stand, and the absence of veins can be noted in Figure 14. The procedure and result, thus far, correspond to the positive Trendelenburg test. The patient was instructed to remain standing quietly, and in one minute I could observe the veins filling from below. In four minutes, the entire saphenous was again distended to its original appearance, as is evidenced in Figure 15. It became clear to me then, that even though the various valves were deficient, the blood flow, clinically, was still towards the heart, propelled by the driving force through the

capillaries. Had the tourniquet been removed before the veins filled from below, it is true that they would have been filled by the reflux of

the saphenous vein. And this has occurred even though the patients were standing and the solution used was slightly heavier than



FIG. 13.

FIG. 14.

FIG. 15

FIG. 13, Case IV. Varicose veins of left leg with positive phase Trendelenburg. Blood specific gravity is 1.048.

FIG. 14, Case IV. Absence of veins after they have been emptied, and tourniquet applied, corresponding to positive Trendelenburg test.

FIG. 15, Case IV. Reappearance of veins after four minutes, patient having remained quietly in same position, with tourniquet still in place.

blood from the femoral above. According to the law of gravity, the column of blood must drop to the level of the blood in the vein below. Following this, however, the blood flows slowly upward with the existing current, which is established by the force of the heart beat and transmitted through the capillaries.

An x-ray study was then made to confirm the clinical results obtained. Figure 16 clearly demonstrates the oil ascending in the saphenous, substantiating the accuracy of the clinical test. Even the plunger was driven to the upper end of the syringe, indicating the centripetal force present in the blood stream. There are, therefore, 2 cases of positive Trendelenburg phase in which the solution has ascended in

either blood specimen. There is no doubt that the flow of blood is centripetal.

CASE V. Figure 17 represents a case of double Trendelenburg phase in the left leg, with the blood specific gravity of 1.056. The vein designated by the ink dot was injected with 2 c.c. of the iodized oil. Figure 18 indicates an ascending and descending movement of the oil. During normal respiration, with the patient standing quietly for three minutes, the position of the globules did not change. The solution remained entirely within the superficial system. Deep inspiration caused the oil to rise, whereas forced expiration caused it to descend. Straining produced marked descension.

CASE VI. Figure 19 is also one of double Trendelenburg phase in the left leg. The blood specific gravity is 1.051. The large vein on the

normal respiration, the oil was seen to rise in the deep and descend in the superficial veins.



FIG. 16, Case iv. Iodized oil ascending in tortuous saphenous vein. Plunger has been forced up full length of syringe.

inner upper aspect of the calf was injected with 2 c.c. of the iodized oil. Fluoroscopically, the solution was seen to descend immediately to the level of the mid-calf where it entered the deep system through the communicating vein. Figures 20 and 21 demonstrate this quite clearly. Deep inspiration forced the oil slightly down in the superficial system and slightly up in the deep system. Forced expiration stopped the normal flow from the superficial to the deep system. Straining forced the solution further down in the superficial vein and also stopped its ascent in the deep vein. Relaxation allowed the oil to rise slightly in both venous channels. During further observation, with

FIG. 17, Case v. Varicose veins of left leg with double phase Trendelenburg. Blood specific gravity is 1.056.

CASE VII. Figure 22 presents a case of double Trendelenburg phase in the right leg, with a blood specific gravity of 1.055. Following the injection, the oil immediately ascended in the superficial system, as can be noted in Figure 23. Deep inspiration forced the oil down, whereas forced expiration allowed it to rise. Straining produced marked downward flow of the oil.

There are therefore, 3 cases, all of the double Trendelenburg phase, in which the behavior of the injected iodized oil has

than the valves. Similarly, in both cases with the positive Trendelenburg test, the iodized oil ascended in each instance. But

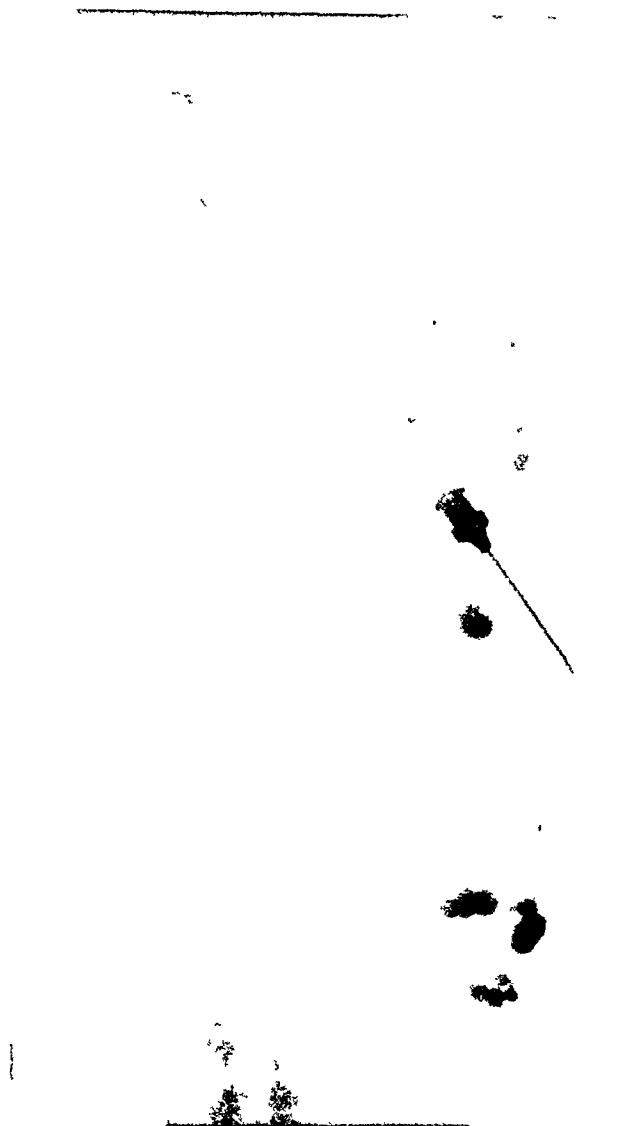


FIG. 18, Case v. Iodized oil visualized above and below site of injection.

differed in each. In all these cases, one or more valves of both the communicating and superficial systems were incompetent. Were the flow of blood dependent upon these valves, the direction of the oil should have been similar in each instance. And according to the generally accepted opinion, the direction of that flow should have been from the deep vein, through the communicating and up the superficial system. Yet, the fact that this did not occur certainly indicated that the predominant influencing factor was something other

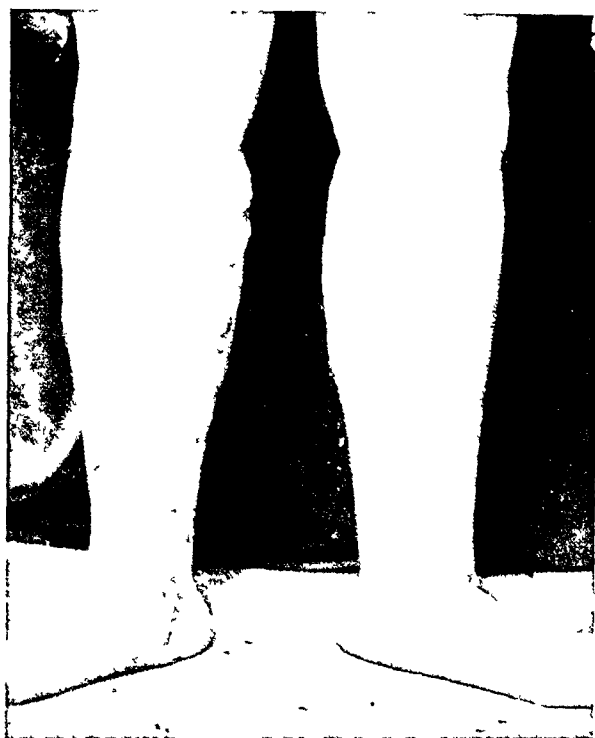


FIG. 19, Case vi. Varicose veins of left leg with double phase Trendelenburg. Blood specific gravity is 1.051.

with the valves incompetent, the flow should have been reversed, according to Trendelenburg. The results in all these cases lead me to believe, therefore, that the incompetency or insufficiency of the venous valves in varicose veins does not in itself alter the direction of the blood flow. It is also my opinion, that in cases of positive phase Trendelenburg, the flow of blood is toward the heart and not reversed, whether the patient is in the standing or horizontal position.

The actual function of the valves in normal veins, I believe, is to prevent a sudden increase in pressure in the segments below them, whether the pressure be due to straining, coughing, body weight, constriction, or pelvic tumor. The valves in the saphenous vein, when efficient, may distribute this increased pressure equally to all segments of the vein, but they do not control the upward flow of blood. Undoubtedly, their inefficiency decreases the rate of flow towards the heart by increasing the

existing pressure in the vein. But it must be remembered that there is a driving force from the heart that is transmitted through

Even if the blood stream were reversed, what would prevent an embolus, if it did present itself, from entering the deep

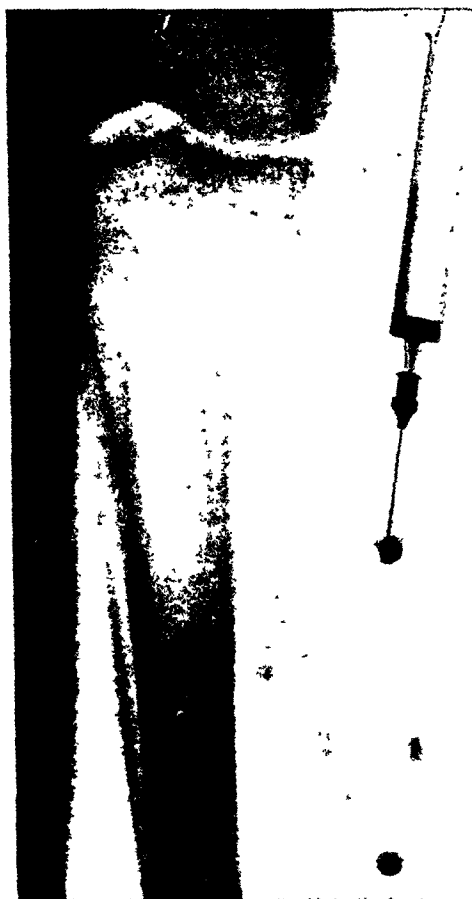


FIG. 20, Case vi. Descent of oil to lower third of calf where it enters communicating vein to ascend in deep system.



FIG. 21, Case vi. Same as Fig. 20.

the arteries and capillaries, that continues to force the blood up the vein, even though its rate is diminished.

It appears logical to me, therefore, that the important factor that not only determines the direction of flow, but also the rate of flow, is the difference between the pressures produced by the driving force through the capillaries below, and by the weight of the column of blood above. The width of the vein or the blood stream also affects the rate of flow in the inverse proportion.

The evidence presented in support of the upward flow of blood in varicose veins should not discourage the injection treatment of these veins for fear of emboli.

system through the communicating veins and ascending to the heart? The fact is that emboli following the sclerosis of veins are rare and as a general rule need never be feared.

I am greatly indebted to Dr. I. Tunick, chief of the Varicose Vein Department at the Joint Disease Hospital, who originally inspired me to follow my experimental work in varicose veins, and who has since been an invaluable aid to me.

I am also greatly indebted to Dr. B. Wolfort of the Brooklyn Jewish Hospital, in whose orthopedic department the vein clinic functions as a subsidiary. It was from this clinic that the material was obtained for this presentation.

For the x-ray demonstrations in the first 2 cases, I extend my heartiest thanks to Dr. M. Wasch and his staff at the Brooklyn Jewish

cases, in addition to the fluoroscopic data observed. For this cooperation I am indeed grateful.

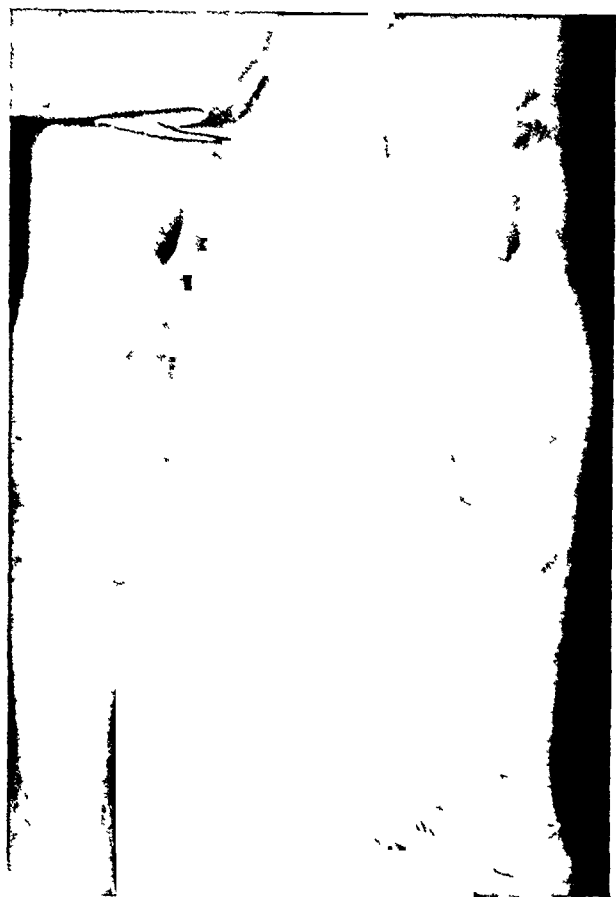


FIG. 22, Case VII. Varicose veins of right leg with double phase Trendelenburg. Blood specific gravity is 1.055.

Hospital. The untiring efforts of Dr. H. Greenfield have made it possible for me to present the x-ray illustrations in the remaining



FIG. 23, Case VII. Marked ascent of oil in saphenous vein. Lighter duplicate shadow of syringe is due to accidental double x-ray exposure on same plate.

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HOSPITAL CARE OF UPPER EXTREMITY FRACTURES*

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THE treatment of fractures of the upper extremity is based upon the fundamental principles that apply to all fractures of the long bones: first, reducing the deformity at the earliest possible moment following the injury and second, maintaining the corrected position for a sufficient time, without disturbance to the muscular and skeletal structures, to permit the normal reaction of repair to stabilize the position of the fragments.

While these principles may appear elementary to the experienced surgeon they are, nevertheless, matters of great importance to be constantly observed in the hospital care of fractures, as they often appear to be lightly considered and in some instances totally disregarded. To some surgeons the chief interest in fractures is confined to the diagnosis of the type and degree of bone injury by a review of the x-ray films and a casual inspection of the patient. Beyond this his personal contact with the case is seldom followed with any noticeable degree of enthusiasm. Far too often the treatment is superficially discussed and the problems hastily disposed of by recommending this or that method of treatment while the actual disposition of the reduction and immobilization is relegated to a junior assistant, or in some instances, to a member of the house staff who may be frank enough to admit that he has little more than textbook knowledge of the treatment of fractures.

To other surgeons the treatment of fractures assumes entirely different proportions, in which greater care is exercised in the diagnosis and in the various stages of treatment, with emphasis on the necessity of studying the particular factors involved in each case. Under these conditions the treatment that is prescribed is usually sufficiently interesting, and suffi-

ciently difficult in its execution, to warrant the undivided attention of the most skillful member of the attending staff.

Overemphasis of x-ray diagnosis and the growing tendency to delay the early reduction of the deformity is another serious error that may occasionally develop in a large hospital and in some instances may assume astounding proportions. The practice of leaving the diagnosis of fractures to the x-ray department is obviously wrong as it places an unfair responsibility upon those who were never intended to assume it. It further minimizes, and often totally disregards, the clinical evidence of skeletal injuries the ultimate effect of which is the growing inexperience with fractures which is evident in the faulty diagnosis of bone injuries, and the lack of confidence in the selection and management of the apparatus that is most suitable for the various types of fractures. It may be confidently stated that the function of the x-ray in the diagnosis and treatment of fractures cannot be minimized but it nevertheless has its limitations which confine it to the verification of the initial clinical findings, and following the reduction, to the correct estimation of the skeletal alignment.

Having arrived at the final diagnosis after a complete physical and x-ray examination, one must select the apparatus that is most suitable for the fracture and avoid the error of trying to make the fracture conform to the principles of the apparatus.

In all instances the demands and comforts of the patient are of prime importance. Personalities and methods of treatment must be subordinated to the concerted efforts of the surgical staff to secure the best possible reduction of the deformity and the readaptation of the individual in the shortest possible time. It may be

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stated with assurance that there are no short-cuts in the treatment of fractures and that no special methods of treatment have priority over others, unless it can reasonably be expected that they will correct the deformity or improve the function of the extremity. Good functional results are in direct proportion to the degree of surgical skill that the hospital staff can provide and to the character of the equipment placed at their disposal for the care of the patient. Good results may be obtained under the care of a skillful surgeon, but better results will be obtained by a good surgeon having good equipment.

Patients may observe that some hospitals secure a higher average of good results than others. In exceptional instances this may be due to the individual initiative of one or more members of the surgical staff while in the majority of instances it is due to the recognition by the hospital administration of the importance of specialized care of fractures and the necessity of adequate equipment for the efficient care of bone injuries. In such institutions the treatment of fractures is not relegated to one individual with the expectation that he will personally administer each and every phase of the treatment; on the contrary, it attempts to provide specialized care administered by numerous assistants from the various departments each of whom must be responsible for their conduct of the case to a designated member of the surgical staff. The surgeon who is chosen for this duty should be able to demonstrate his ability by his individual accomplishments, training and experience and should have the desire to follow a specialized branch of surgery that is most intimately associated with skeletal injuries and deformities. In brief the treatment of fractures has become a matter of departmental organization with specialized surgical treatment supplemented with adequate and efficient equipment.

The chief of the fracture service must

not only provide the training and experience that is necessary for the position but he must also stimulate a spirit of research and investigation among the members of his staff in the etiology and pathology of bone diseases. He must encourage them to become familiar with the deformities that impair the function of the spine and extremities and a knowledge of the accepted methods of treatment for each. He must bring to the surgical staff correct information of the various types of apparatus employed for the correction of deformities of the extremities and to be able to utilize these mechanical principles in the treatment of fractures. The extent and character of the numerous problems that arise in the treatment of bone injuries are sufficient to demand the entire time of his daily visits to the exclusion of other important surgical problems. He must personally enter into the actual treatment of all cases and not be content with the mere supervision of the work of others. It is his duty to respond to emergency calls, institute methods of diagnosis and personally undertake the treatment of all serious cases to insure the patient the best anatomical and functional results of his injury. Provision must be made for the instruction of the assistants and the interne staff, supervision of the equipment and conduct of the emergency ambulance service, verification of the diagnosis and treatment of the admitting officer and the insistence on the early and complete reduction of the fractures without delay. The hospital case records must be constantly reviewed by the chief of the service to insure proper notation of the clinical records which should contain frequent notes of the treatment and the condition at the time of discharge. Finally he must assume full responsibility for the surgical and physical well being of the patient and be able to present to the surgical director full and accurate knowledge of the patient's condition during the entire period of treatment.

Hospitals having a fracture service of

this character can provide immediate treatment to the patient upon entering the hospital and can reasonably expect

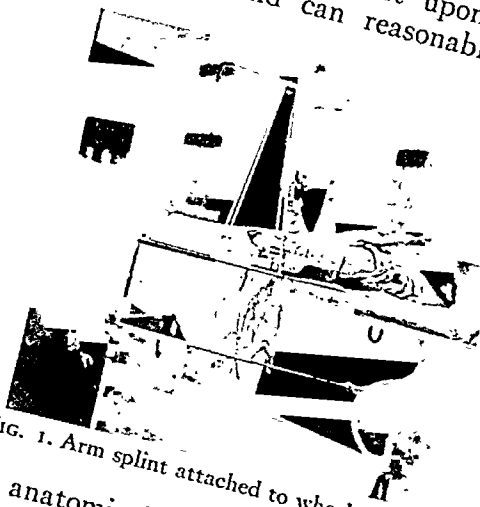


FIG. 1. Arm splint attached to wheel carriage.

of position during the nursing care, all of which may disturb the corrected position of the fracture. In the later periods of the treatment the application of physiotherapy, and in special cases the frequent dressings of compound fractures, all tend to disturb the constant application of traction and may even jeopardize the most skillful initial surgical treatment. The difficulties that arise in the treatment of fractures of the upper extremity and the frequent handling of the patient by numerous assistants during the period of bony union make it imperative to constantly guard against the possibility of malposition of the bony fragments. Failure to observe extreme care in this regard has been the chief cause of many personal disappointments and has led to the desire to select a special type of apparatus that will minimize these dangers and add if possible to the efficiency of the various types of apparatus that are commonly used. The instrument here described was designed with these facts in view and has been sufficiently successful to warrant a detailed description of its construction and the principles that are employed to overcome the common difficulties encountered with injuries of the arm and shoulder girdle.

The upper extremity splint consists of a single unit that is constructed of steel and can be firmly attached to either the bed or wheel carriage. The bed or wheel carriage can be moved safely over smooth floors or on elevators as frequently as necessary without fear of disturbing the position of the skeletal injury. The use of this apparatus emphasizes the importance of recumbent treatment for most injuries of the upper extremity and is designed to minimize the resistance to traction and counter traction and to insure strong continuous pull in the axis of the bone. Consideration is also given to the many nursing problems that arise during the convalescence that might be otherwise neglected in difficult cases if their existence

good anatomical restoration of skeletal deformities. When one dealing is with severe fractures that require a general anesthetic for their reduction, and in all cases of compound fracture, the emergency treatment is assumed by the surgeon in charge. It is needless to say that the character and condition of the fracture equipment are matters of extreme importance which necessitate constant supervision in the selection of the apparatus and the manner in which they are kept for emergency use. Whenever possible one reduction should be made and the permanent apparatus applied at the earliest moment. The type of apparatus selected should be chosen especially to suit the particular type of fracture, and in the case of fractures of the long bones, should provide traction that is adequate to overcome the deformity. They should be sufficiently comfortable to the patient to withstand prolonged immobilization.

The fulfillment of these requirements is not always an easy matter in large institutions as provision must be made to verify the reduction by frequent x-ray examinations that may require the removal of the patient from one part of the building to another. It may also be necessary to transport the patient to the operating theater as well as to make constant changes

were not anticipated and measures taken to correct them.

To facilitate the frequent changes of

in the event the patient is to be transported. The suspension sling is made of light netting which encircles a metal co-

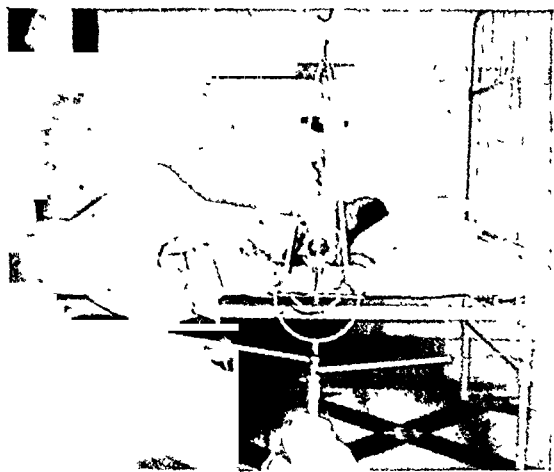


FIG. 2. Apparatus attached to the fracture bed.

position and to permit a reasonable amount of movement during the recumbent treatment we make use of a horizontal rail and sliding section which permits the suspension unit to move toward and away from the patient without interrupting the support and traction in the axis of the bone. The rail is supported from the floor by a small carriage mounted on a base with roller bearing wheels and is connected to the bed frame by a strong connecting rod with an adjustable clamp. The horizontal rail may be altered in its position to permit frequent changes in the direction of the axial traction and may be raised or lowered to obtain flexion or extension of the shoulder joint. A similar support is provided to be attached to the bed without the floor support if the conditions warrant its use.

The suspension unit is mounted on four wheels and moves freely in the horizontal position. It is placed between the traction force and the counter weight of the body and holds the arm in suspension in one plane corresponding to the axis of the forces acting on the skeletal structures. The apparatus provides for traction, counter traction, suspension and immobilization and is so constructed that it can be firmly clamped to the bed and quickly removed to the wheel carriage

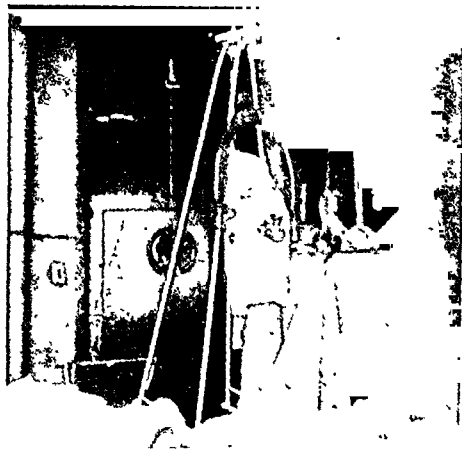


FIG. 3. Piano wire suspension for compound fractures of the metacarpal bones.

aptation splint placed immediately below the line of fracture and is connected to a weight attached at the end of the rails.

Traction is of the weighted type consisting of metal tubes each of which contains small pellets of lead for the application of graduated weight. The amount of pull on the arm is indicated on a scale inserted in the axis of the traction cord. When surface traction is used we have a preference for moleskin plaster which is more durable and adheres to the surface of the skin for a longer period without irritation. When skeletal traction is used we prefer the Kirschner piano wire or Steinmann pin, being careful to cover the skin with adesor or mastisol to avoid skin infection. It has been found that adhesive traction from three surfaces of the arm permits a stronger pull on the proximal fragment and, to insure an equal pull on all three strips of adhesive, we have designed a spreader that allows for frequent correction of the length of the adhesive strips and at the same time prevents slipping at the points of attachment.

The proximal end of the rails is attached to a triangular pad of sponge rubber which conforms to the size and shape of the scapula. The pad securely attaches the end of the splint to the shoulder girdle to which it is attached by three leather straps

thickly padded with felt to prevent skin irritation. In addition to the straps, the superimposed body weight stabilizes the end of the splint and furnishes an excellent point of counter fixation. It also elevates the shoulder from the surface of the bed and brings it into the same horizontal plane with the abducted arm.

FRACTURE OF THE CLAVICLE

The frequent deformity of overriding and angulation at the point of fracture of the clavicle is due to insufficient traction and failure to obtain full abduction and extension at the scapulo-humeral joint. This is explained in most instances by the common practice of selecting the ambulatory type of treatment in preference to the recumbent treatment in bed during the period of fibrous union. The mechanical disadvantages of trying to secure sufficient immobilization with the ambulatory treatment are too difficult to overcome when treating fractures of this bone. The T splints and clavicular crosses that are commonly used are either too loosely applied to maintain the corrected position for a sufficient time to obtain fibrous union, or they are too uncomfortable to endure when an attempt is made to hold the shoulder in full extension and elevation. In such instances the patient usually demands its release for comfort and the rigid fixation of the shoulder is sacrificed to his wishes.

With this experience in mind and supported by better judgment in applying the true mechanical principles to correct and immobilize the deformity we have adopted the recumbent type of treatment during the period of fibrous union as it is the most comfortable and most efficient method of treatment that can be used for traction and immobilization of the arm over a period of time. The elevation of the shoulder is of importance and is obtained by placing the triangular pad beneath the scapula to insure extension at the shoulder joint while the arm is abducted above the right angle position. These mechanical

forces may be maintained for an indefinite period by means of the sliding suspension apparatus while the necessary nursing care can be attended to with the least discomfort to the patient.

During the convalescent period x-ray examinations may be made as frequently as desired without fear of disturbing the traction. The apparatus is applied soon after the patient is admitted to the hospital and remains undisturbed through the period of fibrous union. When the repair of the fracture has been sufficiently established to prevent disengagement of the fragments, a plaster of Paris jacket with a minerva collar is applied and the patient allowed out of bed until bony union is complete. In exceptional instances a manual reduction of the deformity is attempted under anesthesia and the plaster of Paris applied immediately thereafter. If the reduction is successful the plaster is continued during the entire period of healing. When the reduction is not successful the recumbent type of treatment is more desirable.

DISLOCATION OF THE SHOULDER JOINT

Following the reduction for a dislocation of the shoulder the sliding traction splint is applied with the arm in a position of abduction of 45° from the side of the body. This position is maintained for a week or ten days to permit normal repair of the torn capsule of the joint and during this period physiotherapeutic treatments can be administered without fear of redislocation. In the event of a more serious injury consisting of a dislocation of the humeral head following a fracture of the neck of the humerus the treatment usually requires operative measures for the correction of the deformity. The period of immobilization following the operation in such instances is greatly facilitated by the sliding splint and skeletal traction on the humerus.

FRACTURES OF THE UPPER END OF THE HUMERUS

Fractures of the neck of the humerus, especially with some degree of displace-

ment of the head, are best controlled with traction in the axis of the shaft while the arm is abducted to right angles from the line of the body. This position forms a muscular sleeve about the joint and places the axes of the various muscles in one general plane which corresponds to the axis of the humerus. When the direction and force of the muscle action can be controlled the conditions are favorable for the reduction and immobilization of the fracture and there remains only the necessary period of bone healing to control the fragments. It is during this period that care must be exercised in the use of all forms of apparatus to avoid interruption of the traction forces which permit a malposition of the fragments and subsequent deformities. Surface traction of moleskin adhesive is sufficient in the majority of cases and will remain firmly adherent to the skin surface during the entire period of fibrous union. In the event of a more serious deformity with a displacement of the humeral head suitable measures of a surgical character must be employed before the apparatus is used.

FRACTURES OF THE GREATER TUBEROSITY

Fractures of the greater tuberosity, which are chiefly due to indirect muscle violence, are best controlled with the arm in abduction and sufficient external rotation to permit complete relaxation of the muscles that have their insertion near the line of fracture. Injuries of this character require only suspension of the arm and forearm with enough traction to control movements and only in exceptional cases are surgical measures employed.

FRACTURES BELOW THE TUBEROSITIES

Fractures immediately below the tuberosities of the humerus may sometimes be quite difficult to control because of the anatomical distribution of the muscular insertions at this level. When the line of fracture is above the insertion of the pectoral muscles and the latissimus dorsi the lower fragment is usually adducted

while the upper fragment is abducted and externally rotated. The reduction of this deformity makes it necessary to place the lower fragment in line with the upper one. The degree of abduction will necessarily be governed by the position of the upper fragment and will vary in individual cases. When the line of fracture is below the insertion of the muscles the upper portion of the bone may be adducted and firmly held to the side of the thorax while the lower fragment is pulled upward and outward producing a marked deformity. The correction of this type of fracture requires considerable traction to overcome the shortening, while the line of force must remain in the axis of the upper fragment. An increase in the angle of the deformity will develop if the angle of abduction of the arm is too great due to the adduction of the upper fragment and its fixation by strong muscular spasm.

When surface traction is applied soon after the injury it is reasonable to expect that the deformity will be reduced. In some instances the axial force that is required to overcome the shortening may be very great and it may become necessary to resort to skeletal traction by the insertion of piano wire through the bone until the deformity is reduced.

FRACTURES OF THE SHAFT

Fractures through the shaft of the humerus are either spiral or transverse and are generally well controlled when traction is applied. When one is dealing with fractures of this type, however, the suspension sling at the point of fracture must be carefully controlled, and in some instances balanced with the traction force to prevent angulation. Fractures of the shaft, especially when they are comminuted, may require skeletal traction to insure adequate pull to overcome the deformity. A Steinmann pin or the Kirschner piano wire through the olecranon process serves admirably for this purpose. In all instances the position of the shoulder, the position of the fracture and the position

of the traction must be in the same horizontal plane in order to maintain correct alignment of the skeletal fragments. Compound fractures that require daily dressings may easily be cared for with the sliding suspension apparatus without interrupting the traction and suspension forces acting on the bone.

FRACTURES OF THE LOWER END OF THE HUMERUS

Fractures of the lower end of the humerus and epiphyseal displacements that are so frequently met with in children are usually best treated by extreme flexion of the forearm on the arm. They can be suitably immobilized with cotton and gauze bandage and the arm held in place with a collar and wristlet. When one is dealing with compound fractures at this level, however, the arm must be suspended to facilitate the daily surgical dressings. To correct the deformity and immobilize the fragments under these conditions it is necessary to insert the piano wire through the bone. Fractures of the lower end of the humerus in adults are not as well controlled by the Jones' position. Traction must therefore be applied to fix the fragments, which is best applied by inserting the wire through the olecranon process with the forearm held in a position of semi-flexion. These fractures about the elbow may, in many instances, require operative

measures for their reduction and some form of internal fixation. In all such cases the postoperative care may be facilitated by using the sliding suspension apparatus. When full extension of the elbow is desired, as in the case of fracture of the olecranon process, the position of suspension and traction can be equally well maintained.

FRACTURES OF THE FOREARM

Simple fractures of the forearm do not require the recumbent treatment and are for the most part controlled by manual reduction and fixation in moulded plaster splints. Irreducible deformities may require skeletal traction or open surgical operations in which case the suspension apparatus will serve only for immobilization or to facilitate the postoperative care. Severe compound fractures can be well controlled with the suspension splint in which the forearm can be flexed or extended and the daily dressings made with the least disturbance to the fracture.

Fractures of the lower forearm and wrist joint do not as a rule require traction and suspension but are cared for to greater advantage by other surgical measures. Severe fractures of the metacarpal bones and fractures of the phalanges may require skeletal traction in which instance suspension of the flexed forearm and skeletal traction from above the line of fracture may be the most efficient form of treatment.



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* Continued from p. 427.

CERVICAL RIBS*

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THE subject of cervical ribs is one which concerns the general practitioners because they are usually the ones whom the patients consult when the symptoms appear. It concerns the neurologists because there are usually symptoms pertaining to the nervous system of the extremity involved. It concerns the orthopedists because the symptoms are in one or both of the upper extremities. It concerns the industrial surgeons because trauma and strain frequently cause the onset of the symptoms. It concerns general surgeons because, if the characteristic symptoms are present, the relief is found in surgical treatment.

The progress in medicine and surgery is slow and almost imperceptible. The reason for this is as follows. Some investigator or observer thinks he has made a discovery or has evolved a new thought concerning some subject in medicine or surgery. It takes some time for him to satisfy himself that he has a real contribution to add to the accumulated knowledge on the subject. Then he presents it to some medical or surgical association. His hearers return to their homes and hospitals and put into practice the new thought or discovery. In a few years they report their opinion, and if it is favorable, the new idea eventually finds its way into textbooks and is accepted as a valuable addition to the knowledge of the subject. The whole is a slow process and covers a period of several years.

Dr. A. W. Adson¹ in 1926, a member of the Western Surgical Association, at its meeting in Duluth presented an entirely new conception of the cause of the symptoms produced by cervical ribs when any symptoms were caused. From the time cervical ribs had been discovered to 1926,

they had been looked upon as the sole cause of the symptoms. Dr. Adson presented the new and rather startling idea that the scalenus anticus muscle and the width of its attachment to the first rib, were the principal factors in causing the symptoms, with the cervical rib as a secondary factor.

Since I heard Dr. Adson's paper, my observation and experience have convinced me that his conception as to the cause of the symptoms was correct, and my desire to record this opinion is my reason for presenting this subject here.

While the rib was thought to be the sole cause of the symptoms, there were some puzzling questions concerning cervical ribs. Why did more patients with cervical ribs have symptoms in the right upper extremity, although there were more patients with cervical ribs on the left side of the neck? The cervical rib was a fixed structure. It did not enlarge or contract intermittently. Then why were there intermissions of complete relief from symptoms in some patients? If the cervical rib was the only factor involved why was it that the size or shape of the rib was no indication as to the presence or severity of the symptoms? Why was it that more than half of the patients with cervical ribs had no symptoms? Why was it that an injury or some heavy exercise of the muscles of the neck would frequently start the train of symptoms? Why was it that in most patients the symptoms did not begin till after the age of ten years, and in the majority of patients the symptoms began between the ages of twenty and thirty years?

When we accept Dr. Adson's idea of the scalenus anticus muscle as the primary factor in the cause of the symptoms, these

* Read before the Western Surgical Association, Kansas City, December 5, 1930.

questions are easily answered. More patients are right handed, and use the muscles of the right shoulder and right side of the neck, among them the scalenus anticus, more than those of the left side. There are intervals of complete remission of the symptoms in some patients because of the absence of strain on the scalenus anticus muscle. The size and shape of the rib are no indication as to the severity of the symptoms because they are only minor factors in the production of the symptoms. More than half of the patients have no symptoms because the scalenus anticus muscle does not compress the artery or nerves against the rib. Heavy exercise or injury to the muscles of the neck starts the train of symptoms because of the enlargement of the scalenus anticus. The symptoms being in most patients between the ages of twenty and thirty years because the greatest muscular development, including that of the scalenus anticus, is reached between these ages.

Some observers in the past have vaguely sensed that the scalenus anticus muscle might be a factor, as is shown in their writings, but their attention was so centered on the rib that none of them realized that the muscle was the principal factor. That brilliant surgeon, Dr. John B. Murphy,² committed the error of writing, "As the cervical rib advances forward, it carries the artery and nerves against the unyielding muscle and severely compresses them." After a second thought any one knows that no muscle is unyielding. It is the muscle that compresses the artery and nerves against the unyielding rib. Even so close an observer as Osler³ failed to realize the importance of the scalenus anticus muscle as the principal factor in producing the symptoms. In 1910, he did not mention the muscle as a factor although he reproduced a cut from an article by W. W. Keen⁴ which had under it the legend, "Subclavian artery passing over the rib. Note its high position, its angulation, and the likelihood of pressure by the scalenus anticus."

Dr. Archibald Church⁵ pointed out that nervous symptoms associated with a cervical rib might be induced in an arm by traumatism and by muscular exertion but he did not call attention to any particular muscle. Dr. Church was also among the first authors to state that the patients may have intervals of complete relief from the symptoms.

After many brilliant observers and painstaking investigators had overlooked the part that the scalenus anticus muscle had in producing the symptoms, Dr. Adson made the discovery and the Western Surgical Association should feel honored that the discovery was made by one of its members.

Dr. Adson raised the question as to whether the severing of the attachment of the lower end of the scalenus anticus muscle to the first rib might be sufficient to relieve the symptoms, and that the cervical rib need not be removed. If the symptoms are recurrent with long periods of freedom between attacks, it would seem probable that the muscle was the main factor in producing the symptoms and the severance of its attachment would be sufficient. If the symptoms are continuous and are gradually increasing in extent and severity, it is probably wise to remove the rib also.

The following case history illustrates some of the points brought out in this paper.

H. H., aged forty-six years, was a superintendent of a manufacturing company and was seen on December 20, 1927. He complained of a dull pain that started in the middle of the back of his neck and traveled over to his left shoulder and down his left upper extremity. When present, the pain was continuous day and night. His left hand and arm tingled all the time and his left thumb was numb. He had had attacks of these symptoms for about twenty years. He usually had two attacks of these symptoms each year, but went one year without any. The symptoms lasted from three or four days to three or four weeks. Sometimes the pain was so severe that he was confined to his bed for a week at a time.

On further questioning, he said that about twenty years before I saw him, he was a machinist and worked at a lathe that required him to keep his head turned to the left for long periods of time during his working hours. Two or three days before the last attack began, he was working lying on his back for several hours under his automobile which put a strain on the muscles of his neck. At each attack he received much medicine and many applications of electricity, diathermy, massage, hot baths, hot packs, etc., applied for a diagnosis of neuritis until the symptoms subsided. At the time he came under my care he was in a hospital receiving this treatment.

Nothing abnormal could be felt in his neck. He said his left shoulder felt more comfortable when his left arm was raised. When he elevated his chin and turned it towards his left shoulder and took a deep inspiration of air there was a marked diminution in the left radial pulse. The same thing was true when he turned his

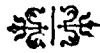
chin to the right under the same conditions but not to such a marked degree.

An x-ray of the cervical spine revealed a supernumerary rib on each side attached to the seventh cervical vertebra. A diagnosis was made of bilateral cervical ribs, the left one only causing symptoms. This was the first case I had seen in which the symptoms came on in attacks with such long periods of relief between. Nothing significant was found in his family history, or in the laboratory findings.

An operation was advised and accepted. On December 30, 1927, the left scalenus anticus muscle was severed from its attachment to the first rib, and for good measure I also removed the left cervical rib. I believe, however, that the severance of the muscle would have been sufficient and would have made the operation simpler and easier. The patient has remained free from the former attacks and symptoms since the operation.

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AN APPARATUS TO REDUCE SHOULDER DISLOCATIONS*

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IN this country surgeons confronted with anterior dislocations of the shoulder usually resort to the Kocher method the muscle spasm is overcome and the capsule is put on a stretch when reduction takes place automatically. In textbooks



FIG.1.

for replacement. This procedure is eminently satisfactory in a large proportion of instances; it is easy of performance, fairly free of danger and successful in all but a few instances. For reduction of dislocations by this method it is absolutely necessary to obtain complete relaxation of the muscles of the shoulder girdle and arm and this usually necessitates the use of an anesthetic. The busy surgeon will meet, from time to time, instances when an anesthetic is clearly contraindicated or when in spite of his best efforts, reduction cannot be effected, at least at the first attempt. Many surgeons under these circumstances will resort to open reduction with its evident disadvantage. It is in this type of case that the Stimson method is so satisfactory. This method consists in making continuous traction on the arm until

this method is usually represented with the patient's arm hanging down through a hole in the table with an attached weight and in the text it is advised to let the arm hang between two tables when a specially arranged one is not at hand; I never saw such a table and the inconvenience of making traction of an arm between two tables is obvious.

The apparatus here described aims to improve on the perforated table; it is simple and can be made by a carpenter in an hour and it has given us so much satisfaction that we wonder if, in a greater percentage of instances, it might not be the procedure of choice, since no anesthetic is necessary and it demands a minimum of skill on the part of the operator. It consists of a board 10 in. wide and 7 ft. long with a braced upright board 12 in. high at its

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middle with a hole large enough to admit the arm readily (7 in. diameter is usually satisfactory). The pulley is fixed at the end of the braced side.

Method of Reduction: While not absolutely necessary, it is usually wise to give a narcotic to allay the patient's fears. The board is passed under the mattress of a standard hospital bed and allowed to rest securely on the frame. A pillow is then placed between the patient's body and the upright board and the arm passed through the hole and adhesive strips are applied in precisely the same manner as in applying a Buck's extension to the leg. It must be remembered that the pull per square inch on the skin is inversely proportional to the number pulled upon, so it is best to have the strips extend well up the arm and at least 3 in. in width. These are then reinforced by circular strips above the wrist, at the middle of the arm and again

above the elbow and the whole arm bandaged securely. Since the traction necessary is considerable, it should be applied with great care. A cross piece is then attached to the adhesive strips and the cord passed over the pulley and the weight, preferably a bag filled with sand, attached. The weight will vary from one-tenth to one-twentieth of the body weight; one-tenth should never be exceeded and even this requires careful watching. With this traction it usually takes between two and three hours to relax the muscles and put the capsule on a stretch with consequent reduction. With one-twentieth of the body weight it naturally takes somewhat longer but this is safer and does not require so much attention. The patient usually recognizes himself when reduction takes place and he will then ask to have the apparatus removed. Subsequent treatment is the same as after other methods of reduction.



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* Continued from p. 418.

CARBON DIOXIDE AS AN ADJUNCT TO SPINAL ANESTHESIA*

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WE need more reliable information relative to the indications and contraindications for spinal anesthesia as well as an accurate explanation of the vascular and respiratory collapse following the injection of anesthetizing substances into the subarachnoid space. If it were not for the alarming fall of blood pressure and respiratory failure occurring immediately or later following subarachnoid injections, spinal anesthesia would almost completely supplant general anesthesia.

The cause of the acute loss of blood pressure has not been definitely proved, the assumption being that the tonic fibers of the vasomotor nerves are rendered functionless by the injection of the anesthetizing agent. Apparently in most instances, a fall of blood pressure occurs before respiration is affected. In some instances, however, respiration decreases in depth before, the blood pressure falls; the latter occurring usually very soon after the beginning of respiratory collapse. Circulatory collapse may occur from an acute loss of vascular tone, which in turn produces an acute ischemia of the medullary centers and myocardiums, resulting in functionless vasomotor and respiratory centers. When an acute respiratory collapse occurs first from spinal anesthesia there soon follows an acute loss of function of the entire medulla, resulting quickly in an acute loss of central or medullary vasomotor function. Under similar circumstances if there is a sudden loss of blood pressure primarily, there soon follows an acute loss of thoracic respiration. Death, therefore, may occur from an acute ischemia of the medullary centers following a loss of blood pressure, which may follow or precede an acute ischemia of the heart muscle. If a

substitute for an ischemic heart could be furnished during this emergency, perhaps an ischemia of the medullary center could be prevented.

BLOOD PRESSURE

Blood pressure is maintained by (1) myocardial and (2) arterial tone against (3) capillary resistance and (4) an ample volume of blood furnished to the heart. Blood pressure may be lowered by a loss of any one or all of the four factors in maintaining it. Myocardial tone is maintained by muscle fibers, an ample blood supply and a stimulation from sympathetic nerve fibers, assisted by resistance from blood in the arteries and capillaries. Arterial and capillary tone is maintained by myocardial contractions, blood volume, blood quality, capillary resistance and stimulation from vasoconstrictor nerves. The greater volume of blood furnished to the heart depends mainly upon respiration and venous tonicity. It is evident, therefore, that blood pressure is influenced mostly, *pari passu*, by the vasomotor system influencing the tone of the myocardium, the arteries and the contractile fibers of the capillaries. This arterial tone is assisted greatly by an ample blood supply to the myocardium and an ample blood volume to the myocardial cavities which in turn is brought about mostly by expansion of the thorax and contraction of the lungs. Thoracic respiration, therefore, is a vital factor in maintaining an ample volume of blood, which must be present in the heart to prevent myocardial ischemia and a loss of arterial tone.

THORACIC RESPIRATION

Thoracic respiration depends upon an accumulation in the blood of carbon

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dioxide, which stimulates the respiratory center in the medulla and which in some unknown manner stimulates only the motor nerves of the diaphragm and intercostal muscles. Why all motor nerves are not stimulated may be due to a phylogenetic lack of necessity. The motor nerves of respiration are the phrenics and intercostals, all spinal and supplying voluntary musculature. Respiration is of voluntary and involuntary types and any normal animal may voluntarily increase its amplitude and rate of respiration until acapnia (Henderson's phenomenon) occurs. This same animal, however, cannot voluntarily cease respiration until death occurs. In other words, thoracic respiration is involuntary up to a certain degree of an accumulation of oxygen and carbon dioxide in the blood. Thoracic respiration ceases (1) when the respiratory center is rendered functionless, (2) when the motor nerves, phrenics and intercostals are blocked, paralyzing the diaphragm and intercostal muscles. Not infrequently the main roots of the phrenic nerves originate within the thoracic portion of the cord. In many instances novocaine interferes with the normal function of motor as well as sensory nerves and when ascending the subarachnoid space, the motor nerves of the intercostal muscles may be blocked and if the phrenic nerves have an intrathoracic origin, they may also be involved. In case the spinal intercostal motor nerves only are blocked, a partial peripheral respiratory paralysis results; and in case the phrenic motor nerves are blocked in addition to the intercostals, a complete peripheral thoracic respiratory paralysis results.

Thoracic respiration, therefore, is brought about by a functioning respiratory center in the medulla and a contraction of the intercostal and diaphragmatic muscles through a stimulation of the phrenic and spinal intercostal nerves. The introduction of subarachnoid anesthesia, therefore, may produce (1) a primary acute loss of blood pressure by an interference with splanchnic vasomotor nerves, which results in an acute

medullary and myocardial ischemia, or (2) a primary block of the phrenics and intercostal spinal nerves which produces a paralysis of the muscles of thoracic respiration. These two most serious complications of spinal anesthesia may precede or follow each other and also occur simultaneously.

Respiratory collapse, therefore, occurs either from a medullary ischemia or a block of the respiratory thoracic nerves and in both instances is always followed by an acute loss of blood pressure. Vascular collapse and respiratory collapse, therefore, always precede or follow each other or occur simultaneously. When a primary block of the motor nerves of thoracic respiration occurs, the only useful form of treatment is an artificial inflation of the lungs, an artificial rise of blood pressure here having absolutely no influence on the restoration of respiration. When an acute vascular collapse occurs without a block of the respiratory motor nerves, an acute rise of blood pressure is therapeutically indicated. This will restore a blood supply of the vasomotor as well as the respiratory center which in turn will result in a stimulation of the intercostal and phrenic nerves. When we have occurring simultaneously a loss of vasomotor vascular tone and a block of the motor nerves of respiration, we have urgently indicated simultaneously a therapeutic application of artificial respiration and a restoration of blood pressure.

An interesting phenomenon is that respiratory and cardiac rates do not increase as the blood pressure falls, which is contrary to shock and hemorrhage. It undoubtedly is due to an acute ischemia of the respiratory center and myocardium, resulting in an acute loss of function.

EFFECTS OF CARBON DIOXIDE

The vasomotor center requires carbon dioxide to stimulate the respiratory nerves, phrenics and intercostals. Why it does not stimulate all motor nerves is interesting, probably due to a phylogenetic exclusion from lack of necessity. When we have an excessive ventilation (acapnia), we have

resulting a fall of blood pressure due to an inhibition of the vasomotor center and a dilatation of the vessels in the splanchnic area. This fall of blood pressure can be restored by administering carbon dioxide.

When air containing 3 per cent of carbon dioxide gas is inspired, an increased depth of respiration occurs during rest and exertion. When 4 per cent is administered, the pulse rate increases and the blood pressure rises and when raised to 10 per cent, headaches and mental confusion occur. With higher percentages the heart rate decreases, the blood pressure temporarily rises but soon falls with the cessation of respiration.

Ischemia of the brain and medulla is secondary in spinal anesthesia to splanchnic loss of tone, which produces also myocardial ischemia and a loss of myocardial contraction, leaving the heart as a hollow tube. If respiration can be made to continue a circulation of blood, it may be sufficient to carry the patient over an acute emergency. It was this thought in mind which induced me to use CO_2 during the time of spinal anesthesia and, if necessary, for several hours following, feeling that if respiration could be made to continue the thorax would act as a temporary heart providing that the motor nerves of respiration were not blocked. Five to 10 per cent carbon dioxide in oxygen is administered through inspiration, as a vasomotor and respiratory tonic, the patient receiving instructions as to the reasons for it. Constant blood pressure readings are recorded, which show a higher average blood pressure than when carbon dioxide is not administered. In 2 cases, however, the blood pressure disappeared completely with imperceptible heart sounds, but respiration continued. For about four minutes in each instance the respiratory excursion were apparently sufficient to keep up enough circulation for vital purposes without any assistance from the myocardium.

CASE I. Male, aged sixty-nine, was explored for a small obstructing carcinoma of the pylorus. Ten minutes after the injection of .2 gm. of novocaine beneath the arachnoid, the

blood pressure and myocardial contractions could not be determined. The respiratory excursion, although reduced about 30 per cent, continued under the administration of 5 per cent carbon dioxide in oxygen and in about three to four minutes, after an intravenous injection of 5 drops of adrenalin 1-1000 solution, the blood pressure started upward reaching 75 systolic and 40 diastolic where it remained until the exploratory operation, which lasted fifteen minutes, was completed. This patient had 6 drops of adrenalin given hypodermically just previous to the injection of .18 cg. of novocaine beneath the arachnoid. In this instance the Trendelenburg position was not used at any time.

CASE II. A woman, aged forty-two, with fibroids of the uterus received .16 gm. of novocaine under the arachnoid through the space between the second and third lumbar vertebræ. The blood pressure oscillated from 120 systolic and 86 diastolic to 70 systolic and 32 diastolic for about fifteen minutes and then disappeared and remained absent for ten minutes with a very feeble heart beat which was practically imperceptible. The head was lowered, before the incision was started, to the average pelvic operative position and remained there until the operation was completed twenty minutes later. Immediately after the acute vascular collapse, adrenalin, intravenously, failed to raise the blood pressure for five minutes after its administration. Carbon dioxide in oxygen was administered continuously during the operation which kept up the respiratory excursion and in turn carried on the necessary circulation of blood.

Both of these patients received 5 to 10 per cent carbon dioxide in oxygen from the time the novocaine was injected until the end of the operation. Since the adoption of carbon dioxide as an accessory, the head of the patient has not been lowered below the horizontal position, excepting in operations upon the pelvis. This has facilitated surgery of the abdominal cavity, which is not true with the Trendelenburg posture.

CONCLUSIONS

1. Spinal anesthesia produces respiratory failure in two ways, viz.: (1) a paralysis of the motor nerves of respiration; (2) a paralysis of the vasomotor nerves of the

splanchnic area which results in a loss of blood pressure followed by a myocardial and medullary ischemia.

2. Carbon dioxide 5 to 10 per cent in pure oxygen is a valuable adjunct in spinal anesthesia when the motor nerves of respiration are not paralyzed. It assists in maintaining blood pressure in most instances and in maintaining the circulation of the blood when the heart contraction ceases from myocardial ischemia due to an acute loss of blood pressure.

3. If a paralysis of the motor nerves of respiration occurs, only artificial respiration can be of service followed secondarily by vasoconstrictor stimulation. If a paralysis of the splanchnic vasomotor nerves occurs primarily, vasomotor tonics are indicated to relieve the myocardial and medullary ischemia.

4. The armamentarium of the spinal anesthetist should consist of an apparatus for artificially insufflating the lungs with

oxygen and carbon dioxide and a vasoconstrictor such as adrenalin.

5. The complications of spinal anesthesia are too great for the surgeon to care for during the operation. They require a special anesthetist who has a knowledge of the causes of respiratory and vascular collapse and who has the means and methods of handling them successfully.

6. In place of doing away with an anesthetist, spinal anesthesia requires one of greater training, due to the greater frequency of serious complications.

7. The spinal anesthetist must keep constantly in mind that respiratory collapse may be of central or peripheral origin, e.g., a functionless medulla oblongata from ischemia or a block of the motor nerves of thoracic respiration. He must also keep constantly in mind that a sudden vascular collapse or loss of blood pressure may be of central or peripheral origin.



RUPTURE OF UTERUS FOLLOWING CESAREAN SECTION*

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CASE 1. Santa Rosa Hospital, San Antonio, Texas.

Mrs. M. H., married, aged twenty; height 5 ft. 2 in.; weight 140 lb. Previous history negative. Towards the end of her first pregnancy, she developed a severe eclampsia.

The first seven months passed without event, when she noticed her feet and ankles beginning to swell. During this time she was not under a physician's care.

Twenty-six days before expected delivery, she became sick and on the following morning had a convulsion and a physician was called, who advised her removal to a hospital. She became worse, and by 5:30 P.M. she had had fifteen convulsions and it was decided to deliver her by cesarean section.

The operation consumed about thirty minutes' time. During the operation she had three more convulsions and was so comatose that the operation was done under local anesthesia. A living baby weighing 6 lb. was delivered but died within twenty-four hours.

Thirty-three postoperative convulsions were recorded from 6:40 P.M. until 11 A.M. the following day, totaling nearly fifty from the time of onset. The shortest lasted one and one-half minutes, the longest about three minutes. The intervals varied from twenty to sixty minutes.

Temperature upon admission was 100°F.; pulse 108; respiration 28. The first two days postoperative she had moderately high temperatures, the maximum being 103.6°F. No convulsions are recorded after 11 A.M. the second day. By 4 P.M. the third day, her temperature had returned to normal. Twenty-four hours later the temperature again rose, fluctuating from 99 to 100.4°F. and continuing so until the end of the ninth day, when it again became normal and she left the hospital per ambulance.

About three months after being discharged she became pregnant again. The date of expected delivery was November 10, 1929.

Santa Rosa Hospital (Mrs. M. H., second admission).

Her condition was quite normal during the second pregnancy up to October 27.

About 2:30 on the morning of October 28, she began having pains suggestive of beginning labor, and was taken to the hospital.

From 3:30 A.M. to 1 A.M. the following morning the patient had only slight pains lasting thirty to forty seconds at intervals of ten to fifteen minutes. At 1:45 A.M., when she began suffering severely, there was a slight bloody vaginal discharge; but at 3 A.M. she became more comfortable and rested well the remainder of the night.

At 8:30 in the morning, she was very sensitive over her entire abdomen and more especially in left lower quadrant, and had a very anxious facial expression.

A cesarean section was decided upon but the diagnosis of uterine rupture had not been made. We considered rupture a highly probable outcome if labor continued.

Upon opening the abdominal cavity, we found it to contain free blood and clots. We saw at once that the uterus had ruptured or yielded in the line of the old scar. The membranes were intact and contained the baby and fluid.

The uterine incision was upon the anterior surface of the uterus. It had yielded a distance of perhaps two-fifths its length. The edges were somewhat roughened and delicate filaments of fibrous tissue and fibrin extended across the upper and lower angles. The wound was quite easily enlarged to its full original length by fingers without the use of instruments. Through this opening the child was delivered.

The placenta was a posterior implantation; the baby was dead; and evidently had been for several hours as blebs had already formed on parts of the skin. The cord seemed short and was twice about the neck. The child was a fully formed, well-developed baby of probably 7 to 7½ lb.

The uterine wound was closed by three layers of chromic catgut and the abdominal wound by the usual layer method with cigarette

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drain in the lower angle. The time consumed was about thirty-five minutes. She left the operating table in good condition. The patient had a stormy convalescence but left the hospital on the thirteenth day. She continued her convalescence at home.

Briefly, the signs of rupture of the uterus are a crisis of agonizing pain, then cessation of pains and collapse of the patient. This woman continued to have pains up to the time of going to the operating room and there were no symptoms of collapse or even mild shock.

The striking thing to me about this case was the seeming little force required to produce rupture.

Concerning rupture of the uterus, the predisposing conditions are: infection in the uterine incision; faulty closure; location of the incision. Contributing factors are: malpresentations; abnormally large baby; hydrocephalus; resistance to the oncoming head; and contracted and deformed pelvis.

It is now generally agreed that when cesarean cases run a postoperative febrile course, it is fair to assume there has been infection in the uterine incision, resulting in faulty healing. For a long time it was thought the uterine incision healed by scar tissue formation whether infected or not; but Williams pointed out that only when proper healing resulted was there regeneration of muscle tissue. He showed this by histological sections taken from incisions where proper healing had resulted.

Imperfect healing may result in union by scar tissue or partial muscle regeneration and partial fibrous union. In both instances, the scars are weak and may result in rupture when subjected to the strain of labor.

Reviewing the postoperative record in the first case, we find this patient had fever until 4 P.M., the third day, when it temporarily became normal. This probably was a continuation of the fever caused by eclampsia. The second rise, continuing for the remaining six days in hospital, was

probably due to the infection in the uterine incision.

For suturing the uterine wound, many European surgeons believe silk is the better material to use, while American surgeons largely favor an absorbable material such as chromic catgut. Suturing in tiers as introduced by Sanger is undoubtedly the best method.

A high incision undoubtedly results more often in a weak wound and subsequent rupture than the low cervical. The technical difficulties in doing the low operation may be greater to some than the classical. Reports show that there is less danger of subsequent rupture in the low cervical operation.

Symptoms of rupture vary. In some instances there may be the classical signs of rupture. These are usually the cases rupturing during the early stages of labor. If the uterus survives the assault of beginning labor, women are delivered in many instances without rupture. Cases are recorded where women after cesarean section have gone through two normal deliveries to have the uterus rupture at the third delivery.

Rupture may occur spontaneously at any time during pregnancy, in some cases without pain or warning. If during the early months, the symptoms are more those of a ruptured ectopic pregnancy. The early rupture cases have a lower mortality than those rupturing during the latter months.

CONCLUSIONS

All cesareanized women having a history of a postoperative febrile course are potential rupture cases and should have extra watchful care during the entire course of a subsequent pregnancy.

A weak scar may result from faulty healing without infection; but in the instance reported here, we feel the cause was from infection in the former uterine incision.



GAS BACILLUS INFECTION IN CIVIL LIFE*

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ACCORDING to the reports in current literature, gas gangrene is becoming more and more prevalent in civil life. Weintrob and Messeloff¹ record 85 cases in civil practice in which *B. welchii* was found to be the predominating organism. Forty of these cases were characterized by gas bacillus infection in the extremities, the mortality of which was 50 per cent. The mortality in the total series of cases was 45.9 per cent. The increase in the number of gas bacillus infections is no doubt due to the increasing incidence of severe injuries resulting from the automobile and the highly developed mechanical age in which we live. This increase is associated, however, with a better understanding of the condition itself and the necessity for prompt measures to prevent fatal termination.

Forney² states that the motor vehicle deaths in 1929 numbered 31,500. The approximate death rates per 100,000 population and per 100,000 cars from 1918 to 1929 are as follows:

	Deaths per 100,000 Population	Deaths per 100,000 Cars Registered
1918	9.6	158
1919	9.8	130
1920	10.4	126
1921	11.6	117
1922	12.3	112
1923	14.8	108
1924	15.8	102
1925	16.8	98
1926	18.0	96
1927	19.5	101
1928	20.6	102
1929	23.0	107

It has been the experience of the Metropolitan Life Insurance Company³ that approximately one-third of the accidental deaths reported are due to automobile fatalities. According to this

company in 1929 the 31,500 deaths which occurred through the agency of the automobile were accompanied by nearly one million more or less disabling injuries.

Etiology: *Clostridium welchii* *Bacillus aerogenes-capsulatus*,⁴ *Bacillus phlegmones-emphysematosae* (Fraenkel), *Bacillus perfringens*, (Veillon and Zuber) for many years was believed to be practically the only species which could produce gas in the tissues. The organism is found in the intestines of man and animals and is widely distributed. Later researches have shown that while *B. welchii* or *Bacillus perfringens* may represent the most important specific microorganism involved in gas gangrene mention should be made of other organisms.

Vibrio septique (*Bacillus septicus* [Arloing and Mace] or the malignant edema bacillus of Koch) was first isolated by Pasteur from the blood of animals dead from anthrax. According to Weinberg and Sequin⁵ this organism was definitely isolated thirteen times during the War. Vincent⁶ claims that *Vibrio septique* is found in 10 per cent of cases of gas bacillus infection.

It is believed by most bacteriologists, especially the French, English, and American, that Koch isolated an organism which corresponds to the *Bacillus sporogenes* of Metchnikoff, although many German bacteriologists still feel that Koch's organism represented the true bacillus of malignant edema. Other gas producing organisms which are not usually regarded as frequent causative factors, but rather as associated with *B. welchii* are *B. novyi* (*B. edematiens*) and *B. histolyticus*. It is thought, however, that *B. welchii* perhaps may be found now and then. The other gas producing organisms mentioned here

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may be found in association with *B. novyi* but whether they are important as causative factors is open to question.

Accompanying *B. welchii* or other anaerobes, facultative anaerobes may be present, such as *B. proteus vulgaris*, streptococci, staphylococci and other forms.

Bacteriological Diagnosis: The organism may be obtained both by smear and by culture. Blood cultures are usually negative. Cultural and microscopical observations should be confirmed by results of animal inoculation. Smears from the lesion as well as from the culture, if positive for *B. welchii*, will show large, gram-positive, rod-shaped organisms. During the War the following routine was carried out in the laboratories as a presumptive test by cultural methods: tubes of litmus milk previously boiled to drive off oxygen are inoculated with tissue or material from the wound and after incubation for a period of from twelve to seventeen hours, if *B. welchii* is present, the cultures will be characterized by acidity, coagulation and excessive gas formation. Smears from such cultures show the thick, gram-positive, *B. welchii* rod. In obtaining cultures some of the necrotic tissue should be secured directly from the localized area either by means of a sterile aspirator or a sterile swab. This should be inoculated into freshly prepared medium and incubated under anaerobic conditions. Hibler medium or fresh meat extract broth fairly alkaline in reaction and containing 1 per cent dextrose, may be employed. The medium should be covered by a layer of sterile, liquid petrolatum to insure anaerobic conditions. After six to eight hours' incubation, the appearance of gas bubbles points to the presence of *B. welchii* or other anaerobic gas-producing organisms. *B. welchii* is probably the strongest gas-producing organism of the group.

Habitat of Gas Bacilli: It is believed that *B. welchii* and *Vibrio septique* naturally inhabit the alimentary canal of man and animals sp. *B. welchii* may be isolated with-

out difficulty from garden soil and from polluted streams. Gage⁷ has observed gas bacilli in wool and is of the opinion that these organisms are found especially in woolen goods. It is apparent that gas bacilli can exist in the body for a considerable period without gas formation and under certain conditions quickly resume the capacity to form gas and destroy tissues.

Hendry⁸ reports 4 cases in 2 of which the onset of acute gas gangrene was almost ten years after the initial wound. The author suggests that in these cases there were foci of gas bacilli of low virulence which remained latent in the muscular tissues until conditions favored their development.

Two important conditions, devitalized tissues and absence of oxygen, favor the rapid growth of gas bacilli. Lack of oxygen in tissues damaged by trauma or by interference with the blood supply favors the rapid growth of the organisms with gas formation and toxin production. It is possible that the presence of calcium exerts a favorable influence upon the growth of these anaerobes. If such is the case, the calcium resulting in tissues from shattered bone is possibly conducive to the development of the gas bacillus.

Symptoms: The important sign of gas gangrene is crepitation due to the presence of gas in the tissues. The area is at first usually localized and accompanied by inflammation and swelling. Extension apparently occurs by continuity. If an open wound is present, a foul, "mousy" odor may be observed. The patient usually exhibits profound symptoms of toxemia, becomes stuporous with rapid pulse and a rise of temperature. According to Tenopyr⁹ extreme pain and unusual acuteness of intellect are important early suggestive symptoms. History of the injury should always be carefully considered. The diagnosis may be confirmed bacteriologically by recognition of the anaerobic organisms and clinically by the results of surgical treatment and the administration of gas gangrene antitoxin.

Antitoxin: During the early period of the World War the toxin of *B. welchii* was studied with particular care by Bull and Pritchett¹⁰ and by DeKruiff and Bollman.¹¹ It was determined that most strains of this organism produce true toxin when grown in special culture media. The specific action of the toxin could be demonstrated by necrosis of the muscle when injected into the pigeon. Bull and Pritchett's work in the Base Hospital laboratories at the front and later at the Rockefeller Institute resulted in the development of specific antitoxin.

Wallace¹² presents an interesting case report of acute *B. welchii* infection which developed in an individual who received several contusions and lacerations of the right arm which was run over by a truck. The patient was operated on the day following the injury, tentative diagnosis of gas bacillus made, and on the same day perfringens antitoxin treatment was instituted. This patient received a total of four doses of 500 units of perfringens antitoxin and recovered without amputation.

Probably no therapeutic antiserum is capable of producing more spectacular results than gas gangrene antitoxin providing that it is used in conditions in which it is specifically indicated. The reason for this depends chiefly upon the fact that severe infection with the gas gangrene bacillus (*B. welchii*, *B. perfringens*, *B. aerogenes-capsulatus*), and less frequently with *Vibrio septique*, is accompanied by profound toxemia and prostration.

Duval and Vaucher¹³ reported favorably upon the prophylactic value of an antigas gangrene serum prepared from *B. welchii* and the bacillus of malignant edema. The mortality rate was reduced from 16 to 3.5 per cent. Van Beuren¹⁴ reported the successful prophylactic use of antigas gangrene serum among the British and American forces during the latter part of the War.

In civil practice the use of antigas gangrene serum, both as a prophylactic and as a curative, is of importance. It is a well

recognized fact that favorable results usually follow the prophylactic dose of antigas gangrene serum and tetanus antitoxin.¹⁵ It is not difficult to appreciate the importance of antigas gangrene serum when one realizes that the organisms naturally inhabit the alimentary canal and that in diseases in which there is contusion or injury to the pelvic and peritoneal cavities there is danger of liberation of the specific toxins of these anaerobic bacteria. Not only in abdominal lacerations and accidents involving the pelvis and pelvic cavity, but in all injuries, especially those in which crushing of the bone occurs, there is always danger of infection with gas bacillus.

Among the difficult and dangerous complications of acute intestinal obstruction or of peritonitis is paralysis of the intestines. The treatment of this condition has been unsatisfactory. Williams,¹⁶ Bower and Clark¹⁷ and others, as a result of their studies, believe that there is proliferation of *B. welchii* and other anaerobes in the contents of the small intestine of patients with acute obstruction and peritonitis. Molesworth¹⁸ regards such clinical reports as without sufficient basis and sounds a note of caution. The results of the laboratory experiments of Oughterson and Powers¹⁹ do not lend support to Williams' work. However, there is accumulating evidence showing the presence of the specific *B. welchii* toxin in such conditions and the reports from those who have studied this condition and used antigas gangrene serum appear to show promising therapeutic results. Sailer, Laws and Eiman,²⁰ of the Presbyterian Hospital, Philadelphia, have described an interesting case of fatal infection of the intestine with *B. aerogenes-capsulatus* (*B. perfringens*, *B. welchii*).

Kling²¹ reports 4 cases of gas bacillus infection resulting from traumatic injuries. In these 4 cases, two of which terminated fatally, normal horse serum was used in conjunction with the usual surgical treatment. As a result Kling has concluded

that normal horse serum appears to possess a detoxicating action in the presence of gas bacillus infection although from the results of his laboratory studies it was shown that normal horse serum exerts no influence in the neutralization of *B. welchii* toxin. The author believes that normal horse serum possesses some power to exert an unspecific destructive action on the toxin which is thermolabile and is very sensitive to the reaction of the medium in which it is found. Kling suggests the use of 50 to 100 c.c. of normal horse serum for the treatment of gas bacillus infection if the specific antitoxin cannot be obtained. For routine treatment he recommends the use of gas gangrene antitoxin and with the concentrated product suggests a dosage of 10 to 20 c.c.

Standardization of the Antitoxin: The unit of perfringens antitoxin according to the requirements of the National Institute of Health represents that amount of antitoxin which protects a 350 gm. pigeon against one test dose of toxin for a period of twenty-four hours. This is accomplished by injecting one test dose of toxin and approximately one unit of the antitoxin in question. The test dose of toxin is that amount of toxin which kills a 350 gm. guinea pig in the presence of one unit of a standard antitoxin which is furnished by the National Institute of Health.

No official means of a standardization of *Vibrio septique* antitoxin is at present available, but the following method may be used: varying amounts of antitoxin are mixed with one minimum lethal dose of toxin per kilogram of rabbit. This mixture is incubated at 37°C. for thirty minutes. The mixture is then injected intravenously into rabbits which are held under observation for twenty-four hours. The potency of the antitoxin is measured by the neutralization of one minimum lethal dose of toxin per kilogram by the smallest amount of antitoxin which will protect. One unit may be regarded as that amount of antitoxin which will neutralize 100

minimum lethal doses of toxin per rabbit kilogram.

Variety of Clinical Conditions in Which Gas Bacillus Infection May Be Found: Compound Fractures: As stated by Boland²² gas gangrene may be regarded as perhaps the most serious complication of compound fractures. In 80 cases, negro patients, treated at the Grady Municipal Hospital, Atlanta, from 1922–1929, 19 per cent developed gas gangrene. Among the 97 cases of compound fractures in white patients, 7 per cent developed gas gangrene. In the first group, negro patients, there were 11 males and 4 females with ages ranging from five to fifty-two years. The mortality rate was 40 per cent. Thirteen of the fractures in those cases which developed gas gangrene were of the lower extremity which coincides with other reports in the literature, tending to show that a larger number of cases of gas gangrene develop in fractures of the lower extremity. In the series of 15 cases presented by Boland, the bacteriological findings were recorded as follows: 6 cases, presumptive positive diagnosis of *B. welchii* by smear only, 7 cases identified as *B. welchii* by culture, 1 case, *B. welchii* recovered from inoculated animal, 1 case, cultured, negative.

Johnson²³ describes a typical case of gas gangrene resulting from a compound fracture of the lower left tibia and comminuted fracture of the upper left fibula. The fracture occurred on January 9 and the patient appeared to be making satisfactory progress. On the morning of the 18th, a discolored area appeared over the break and crepitus was observed; a circular amputation was performed on the same day and culture made at the time of amputation resulted in the growth of *B. welchii*.

Clifton²⁴ describes a case of compound fracture of the lower ends of the right ulna and radius. In this case, a boy of thirteen, symptoms of gas gangrene were noted on the day following the fracture and a guillotine shoulder joint disarticulation

was done eighteen hours after the injury. *B. welchii* was obtained from the wound. This patient who made a recovery was apparently favorably influenced through the use of perfringens antitoxin as the infection had extended above the operative field.

In Kling's report²¹ 3 of the 4 cases presented had suffered compound fractures. The bacteriological work was evidently done with great care including not only smears and cultures, but animal inoculation as well. The findings in the 3 cases of compound fracture were as follows:

CASE I. *B. welchii* and gram-positive cocci.

CASE II. *B. welchii*.

CASE III. *B. welchii* and *B. edematiens*, (*B. novyi*), the former predominating.

Brickner and Milch²⁵ describe 2 fatal cases of gas bacillus infection resulting from compound fractures. From the first case, *B. welchii* and *B. tetani* were isolated. Cultures from the second revealed *B. welchii*.

Gas Gangrene of the Extremities: Many of the cases reported refer to infection of the extremities. Seven cases were reported by Larson and Pulford.²⁶ The nature of the accidents and bacteriological findings in these cases was as follows:

CASE I. Left hand injured by the sprocket wheel and chain of a tractor while patient was plowing a muddy, fertilized field. *B. welchii* observed in smear.

CASE II. Compound dislocation of the left ankle caused by a fall from a tractor while patient was plowing. *B. welchii* and *Staphylococcus albus* present in cultures.

CASE III. Right elbow crushed against stone wall in automobile accident. *B. welchii* and *Staphylococcus albus* present in culture.

CASE IV. Right hand injured in grain cleaner. *B. welchii* present in culture.

CASE V. Right leg injured in automobile collision. *B. welchii* observed in smears.

CASE VI. Left forearm injured in automobile accident. Cultures showed *B. welchii*, *B. coli*, streptococci and *Staphylococcus aureus*.

CASE VII. Compound fracture of the right thumb due to a fall. *B. welchii*, *Vibrio septique*, *B. coli*, and staphylococci observed in cultures.

Ivan C. Hall²⁷ reports an interesting case admitted to the hospital with injury of left leg above the knee. A diagnosis was made of hematoma with possible thrombosis in the left femoral vein. Three days after admittance the hematoma was opened and the necrotic tissue was removed. Not until two weeks after the injury was there evidence of *B. welchii* infection.

Brickner and Milch²⁵ describe the injury of the muscles of the lower third of the leg in 1 case. An unidentified anaerobic bacillus with *Staphylococcus aureus* and *B. subtilis* was present in the cultures from the wound.

Gas Gangrene of the Brain: According to Schar²⁸ in 1928 only 5 positive cases of gas gangrene of the brain had been reported in the literature and in the majority of these cases *B. welchii* was present. The case described by Schar was that of a boy of fourteen years of age, who, while playing with his comrades, suffered an injury of the eye.* This was done by a bean-pole which was covered with garden earth. Upon examination the physician found that the patient was in a normal condition except for the injury to the left eye which appeared to be so extensive that enucleation was necessary. However, further examination disclosed possible intracranial complications and the presence of meningeal symptoms. It was found that there were two fractures of the facial bones. The child reacted well to the operation, but on the second day startling symptoms developed, such as loss of consciousness, stiff neck, exaggerated reflexes, Kernig's sign, fever and vomiting. The diagnosis was made of meningitis and brain abscess. Material secured from the orbital cavity was sent

* Since the preparation of this paper, reference to gas bacillus infection of the eye has appeared in the literature.

From study of the reported cases, the author below believes that such infection of the eye may be divided into two groups: first, *B. welchii* in association with pyogenic organisms and, second, pure infection with *B. welchii*.

Hamilton, J. B. Notes on *B. welchii* infection of the globe. *Brit. J. Ophth.*, 14: 452, 1930.

to the National Institute for examination and the patient was given antiges gangrene serum. The patient died nine hours after the beginning of meningeal symptoms. The bacteriological examination showed culture of gas bacillus.

Gas Bacillus Infection following Tonsillectomy: Smith²⁹ describes a case of *B. welchii* infection which occurred in a woman of thirty-one following tonsillectomy. Thirty-six hours following the operation, the symptoms were intense headache, pain in the left eye and extremities, preceded by a chill. The patient died after twelve days. Soon after the appearance of the initial symptoms it was possible to make a diagnosis of cellulitis of the face and neck caused by the *B. welchii*.

Fatal Case with Tentative Diagnosis following Extraction of Tooth: About five years ago the sudden death was recorded of Dr. W. H. Doughty, professor of surgery at the University of Georgia Medical School, Augusta. Dr. Ralph H. Chaney, in a personal communication, has given the following information concerning Dr. Doughty's death:

Little exists in record which would prove that his death resulted from *B. welchii* infection. I was not attending Dr. Doughty at the time of his death, but have sought information from those who had contact with the case. Dr. Doughty had been having considerable trouble from arthritis for several months and finally decided to have his remaining teeth extracted. Five days before his death he had a number removed and three days before his death the remainder. I understand that his mouth was rather sore and troublesome after these extractions, but the condition was not sufficiently alarming to suggest to his dentist to have a surgeon see the mouth. His mouth was treated by his dentist the evening before his death. Suddenly about daybreak his wife was aroused by hearing him drop on the floor of his room. He was found unconscious and the physician living next door called. He died within the next hour or so. After the death the body rapidly became distended with gas and the supposition was made that a general gas bacillus infection had taken place. However, I am unable to find that any smears or cultures

were made to prove the type of gas forming organism.

Infection of the Thorax and Thoracic Cavity with B. welchii: Sieman³⁰ reports a case which is interesting because of the infrequent occurrence of infection of the thorax and heart with gas bacillus.

The patient was a student nineteen years of age who attempted to commit suicide with a kitchen knife which he had sharpened on a stone in the garden. The physician found that the patient had apparently self-inflicted superficial wounds in the region of the heart. The wounds were disinfected and dressed and the patient was given a prophylactic dose of tetanus antitoxin and a sedative dose of morphine. Fourteen hours afterwards the patient exhibited symptoms of toxemia and locally a dark discoloration of the skin over the region of the left breast. This area was incised for a distance of about 2.5 cm. Further examination indicated that while the heart appeared to be normal, it was noted on the right side that the respiration was disturbed and sounds were evident. The patient was given an intravenous infusion of 700 c.c. of Ringer's solution. Eight hours after the temperature rose and severe symptoms of toxemia continued until the death of the patient on the third day. At the autopsy *B. welchii* with streptococci and *Staphylococcus aureus* were isolated by Professor Uhlenhuth.

An interesting case of infection has been described by Wolffe.³¹

This case was that of a female, aged sixty-six, admitted to the Mt. Sinai Hospital with pain in the chest. The patient was in a state of stupor with rapid pulse and respiration. The heart was enlarged and the cardiac sounds were distant. Subsequent examinations revealed crackling râles over the chest. Six days after admission, in the right lumbar region a large palpable mass was discovered in which there was definite crepitation. Infection with gas bacillus was then suspected and the patient was given 50 c.c. of perfringens antitoxin. In all 350 c.c. of perfringens antitoxin were administered intramuscularly. *B. welchii* was found in the stools. The diagnosis of infection due to *B. welchii* was based upon a pneumothorax apparently spontaneously absorbed, a migrating pneumonitis without cough, marked toxemia and definite

response to specific serum therapy with recovery.

Pulmonary Gas Gangrene: Loeper and Garcin³² describe a case of pulmonary gas gangrene which was treated by the injection of approximately 8 l. of antigas gangrene serum.

Flaum³³ employed gas gangrene antitoxin in the treatment of 8 cases of pulmonary gangrene, based upon his experience in the French Army during the World War; 20 to 80 c.c. were injected intramuscularly at twenty-four hour intervals. Favorable results were observed in 6 cases.

Perforated Gastric Ulcer with Gas Bacillus Infection: The case described by Dayton³⁴ resulted in death which occurred five hours after the patient first exhibited symptoms. The skin of the neck and superficial structures of the abdomen became distended and crepitant shortly before death. The skin changed from a dirty gray to a light brownish color and at the time of death rapid involvement of the entire body took place, including tremendous gaseous distention of the superficial structures of the face, scalp, upper extremities, chest and thighs. On autopsy a ruptured gastric ulcer was found and *B. welchii* was recovered from the blood.

Vincent³⁵ believes that all lesions adjacent to the alimentary tract may be complicated by gas bacillus infection.

Infection of the Intestine: Sailer, Laws and Eiman³⁰ describe a most interesting case due to infection of the intestinal tract with *B. welchii*. The predominant symptom was acute toxemia which caused the death of the patient. It is stated by the authors that if the perfringens bacillus had not been recognized in smear from the rectum and later positively identified by culture, the diagnosis probably could not have been made. The characteristic symptoms were found to be profound prostration, hypotension, afebrile leucocytosis, fetid odor of the stools and presence of *B. welchii*.

Gas Bacillus Infection in Intestinal Obstruction and Peritonitis: Bower and Clark¹⁷

substantiate the claim made by Williams³⁵ that patients suffering from appendicitis, from acute intestinal obstruction and peritonitis associated with toxemia show marked improvement in clinical condition when they receive *B. welchii* antitoxin and exhibit a lower mortality rate than those not similarly treated. These findings were first based upon the observation that toxemia as seen in such cases with paralytic ileus strikingly resembled the toxemia observed in severe cases of gas gangrene. It is believed that *B. welchii* as it normally exists in the small intestine multiplies rapidly in those patients suffering with acute intestinal obstruction and peritonitis with ileus. In the treatment of 18 such cases of peritonitis Williams had a mortality of 16.67 per cent and in a series of 11 cases Bower and Clark report a mortality of 19 per cent. These authors estimate the mortality control for cases similar to those treated as 73 per cent. A series of 54 cases of intestinal obstruction so treated by Williams showed a mortality of 9.3 per cent as against 24.8 per cent in 214 control cases and 13 cases treated with antitoxin by Bower and Clark, 30.7 per cent.

Owings and McIntosh of Baltimore³⁷ present data which indicate that neutralization of the toxic substances contained in isolated intestinal loops is not influenced by *B. welchii* antitoxin. Experiments conducted on dogs showed that the lives of animals with high intestinal obstruction were not prolonged by the use of the antitoxin. The toxic material contained in the isolated intestinal loops was designated as "loop toxin" and while it was shown that dogs could be successfully immunized with *B. welchii* toxin, the results of the experiments clearly indicated that similar action on the "loop toxin" was not obtained. It is possible that the artificial conditions incident to this experimental work did not simulate those present in clinical intestinal obstruction in man.

McIver et al.³⁸ using the cat as the experimental animal demonstrated *B. welchii* in the obstructed loop of the small

intestine. They were unable to demonstrate any favorable influence through the administration of *B. welchii* antitoxin; however, it is known that the cat is relatively immune to *B. welchii* toxin.

Copher et al.³⁹ believe that both anaerobic and aerobic organisms play a rôle in the production of toxemia found in ileus and intestinal obstruction. The experimental results obtained by these workers followed treatment with *B. welchii* antitoxin of experimental dogs suffering from acute general peritonitis and acute intestinal obstruction, were strongly suggestive of the therapeutic efficiency of *B. welchii* antitoxin.

Recently Simpson⁴⁰ described a post-operative paralytic ileus with recovery after treatment with antigas gangrene serum. Study of the case revealed that the diffuse peritonitis was due to a pneumococcus from some primary focus, presumably in the lung. During the course of the disease a paralytic ileus developed rendering a grave prognosis.

Butler and Rhodes⁴¹ have reported 2 cases of infection with *B. welchii*, following enterostomy for bowel obstruction.

In the first case, a female of fifty-four years of age, bowel obstruction was complete, the symptoms having been established seventy-two hours before entrance to the hospital. Forty-eight hours after enterostomy, the patient exhibited marked symptoms of toxemia and the subcutaneous tissues were edematous and contained bubbles of gas. Cultures showed pure growth of *B. welchii*. Two 100 c.c. doses of anaerobic antitoxin were given at twenty-four hour intervals, and after slow recovery the patient was discharged.

The second case reported was that of a female, aged fifty-five, who was operated on for strangulated postoperative ventral hernia. A few hours after enterostomy was performed, evidences of gas gangrene developed, the diagnosis being confirmed by cultural examination, disclosing *B. welchii* and other anaerobic bacteria, together with the colon bacillus. Although the general condition of the patient showed a definite improvement after debridement and administration of anaerobic antitoxin, death occurred on the ninth day following admittance to the hospital.

Gas Gangrene of the Abdominal Wall following Gangrenous Appendicitis: Shearer⁴² observes that most of the infections with the anaerobic organisms following abdominal operations originate from the organisms in the intestinal tract rather than from material contaminated with these organisms from the outside as is the case with gas gangrene following trauma.

Gas gangrene of the abdominal wall following operation has been found to be very serious in nature. It is apparent that the anaerobic organisms especially *B. welchii* which apparently live under normal conditions in the intestinal tract of some individuals, suddenly become exceedingly virulent.

It is believed by Ochsner and Schmidt⁴³ and others that the gangrenous appendix affords optimum conditions for the growth of *B. welchii*.

Gas gangrene has been reported following operations for perforated gastric and duodenal ulcers, following cholecystotomy, enterostomy and criminal abortion.

Reports in the literature indicate that there are two types of cases of gas gangrene following operations for gangrenous appendicitis; first, those which are localized, second, those in which a general septicemia accompanies the local gas gangrene. The fulminating type is almost invariably fatal, although the use of antitoxin is indicated, especially if an early diagnosis is made.

Butler⁴⁴ enumerates the signs by which may be made a diagnosis of postoperative gas bacillus infection of the abdominal walls as follows: Copper colored bronzing of the skin with edema, brownish foul smelling discharge from the wound, crepitation and positive bacteriological smears.

Puerperal Gas Bacillus Infection: Lehmann⁴⁵ describes 8 cases of gas bacillus infection which occurred in the puerperal state. Together with the gas bacillus there occurred streptococci, staphylococci, *B. coli*, and other pathogenic organisms ordinarily found in such conditions.

Feuillie et al.⁴⁶ describe a case of puerperal septicemia from which *B. welchii* was

recovered at autopsy. Brutt and Lehmann⁴⁷ in discussing some cases of gas bacillus infection complicating the puerperal condition state that when the gas bacillus is present and there are no symptoms of peritonitis, a local infection of the endometrium is indicated and the therapy is curettage and the use of gas gangrene antitoxin.

Nurnberger⁴⁸ describes in detail the diagnosis and therapy of puerperal infection with Fraenkel's gas bacillus (*B. welchii*). According to this author if one finds the following symptoms coincident with illness due to abortion, one may suspect infection with the gas bacillus: Icterus, cyanosis of the skin, red to black-brown discoloration of the urine and brownish discoloration of the blood serum. The presence or absence of fever is not of diagnostic importance. Nurnberger gives in detail methods to be followed in positively diagnosing the gas bacillus by means of microscopic and cultural examination and animal inoculation.

Gas Gangrene of the Uterus: Kamniker⁴⁹ describes a case of gas gangrene of the uterus in a patient twenty-one years of age. Examination of the patient, who exhibited profound symptoms of toxemia, indicated gestation of about eight months. The uterus was tympanic and it was determined that the fetus was dead. It became necessary, therefore, to perform a perforation and extraction of the dead child. This was done and it was found that the fetus was macerated and that gas was present in the uterine cavity. The placenta was removed manually and the patient was given a blood transfusion of 250 c.c. with 500 c.c. of physiologic salt solution. The patient died about six hours after the operation. From the afterbirth *B. welchii* was obtained in culture, this being confirmed by animal inoculation. After autopsy the organism was found in sections of tissue.

Halban⁵⁰ had a similar case occurring two weeks after delivery. Histological examination of the tissues after death

showed the presence of streptococci and gas bacilli. According to Halban's belief the uterus became infected with fecal material.

Hussy⁵¹ describes a case of placenta previa in which the placenta was removed manually and tampons placed in the uterus. The patient was ill for a week suffering from symptoms of toxemia and after finding the gas bacillus in the lochia and a diagnosis of gas bacillus infection of the uterus, a supravaginal amputation was performed. The patient died on the seventh day and *B. welchii* was identified.

A third case has been described by Holmsen.⁵²

Gas Gangrene of the Urinary Tract: Weiser⁵³ describes this condition in a man sixty years of age who up until the time of this illness appeared to be in normal health. The first symptom which was noted was bloody urine. Upon examination it was found that there was apparently some accumulation of gas in the bladder. The presence of a malignant tumor was suspected and the patient was, therefore, transferred to the clinic and subjected to operation. During the operation evidences of gas bacillus infection were observed. Smears from the urethra and bladder showed staphylococci and streptococci, also a gram-positive, plump rod which, when cultivated anaerobically was positively identified as *B. welchii*. The patient died on the sixth day following diagnosis and at autopsy the pathological findings confirmed the diagnosis of infection of the bladder with *B. welchii*.

Ferrier and Bliss⁵⁴ report a case in which *B. welchii* was found in pure culture in the center of branched renal calculus.

Gas Gangrene Infection Introduced by Hypodermic Injection: Wanke⁵⁵ found that 31 cases of gas gangrene had been reported following infection with various medicinal substances. It seemed likely that the syringe was the source of infection. In the Kiel University Surgical Clinic *B. welchii* was found on seven syringe tubes which were kept in 96 per cent alcohol.

TABLE I
CASE REPORTS

Case	Surgeon	Hospital	Nature of Case	Region Affected	Bacteriological Diagnosis		Incubation Period, Hours	Total Units Gas Gangrene Antitoxin Administered	Operation	Result
					Sinear	Culture				
1	Dr. Allen	Harper	Trauma, puncture, wood splinter	Left hand	.....	Negative	48	20,000	Free incisions, irrigation	Recovery
2	Surgical Division	Henry Ford	Trauma, automobile accident	Right forearm	.....	Negative	48	17,000	Free incisions, irrigation	Recovery
3	Dr. Allen	Harper	Trauma, crushing, rag baler	Left hand	.....	B. welchii	56	10,000	Amputation hand	Recovery
4	Surgical Division	Henry Ford	Trauma, puncture, factory worker	Left thigh	Suggestion of B. welchii	B. welchii, hemolytic streptococci	96	9,000	Free incisions, debridement and irrigation	Recovery, suffering from osteomyelitis, myocarditis
5	Dr. Dubois	Harper	Trauma, automobile accident	Left knee	.....	B. welchii	72	30,000	Free incisions	Death tenth day, ileus, impaired kidney
6	Dr. MacKenzie	Harper	Trauma, puncture, street accident	Left lower extremity	Suggestion of B. welchii	Negative	60	20,000	Free incisions	Recovery
7	Dr. Hamilton	Highland Park	Trauma crushing injury, Railroad accident	Left lower extremity	Suggestion of B. welchii	B. welchii	96	2,000	Thigh amputation	Recovery
8	Dr. Gariepy	Providence	Intestinal obstruction	.....	.....	.....	..	6,000	.....	Recovery
9	Dr. Gariepy	Providence	Infection, abdominal wall following appendectomy	.....	Suggestion of B. welchii	.....	48	7,500	.....	Recovery
10	Dr. MacKenzie	Harper	Compound fracture	Left forearm	.....	.....	48	50,000	Amputation at elbow	Recovery

Bancroft⁵⁶ has reported 3 cases of gas gangrene which occurred in a New York municipal hospital as a result of hypodermic injection.

The following Detroit cases which are summarized in Table 1 are reported to illustrate the variety of conditions in which gas bacillus infection may be found and to emphasize the importance of *B. welchii* as the primary etiological agent.

SUMMARY

1. Gas bacillus infection carries a high mortality rate, probably about 50 per cent. Contrary to the general impression which prevailed before the World War, gas gangrene is a relatively frequent and an important infection in civil as well as in military life.

2. It is logical to assume that the mechanical age of today, which is responsible for the rapidly rising number of cases of severe trauma, has brought about the marked increase in the number of cases of gas gangrene. At the same time it may be observed that physicians are becoming more familiar with the etiology and symptomatology of the infection and are better able to recognize the condition.

3. Suspicion should be centered on all cases in which there is severe trauma, crushed bone or deep perforations. Especially should those cases in which there are pelvic or abdominal injuries or contusions be regarded with apprehension. Gangrenous appendicitis affords a potential danger. Proliferation of *B. welchii* should not be disregarded in intestinal obstruction and in peritonitis accompanied with ileus.

4. Among the first symptoms which may occur in from six hours to three days following inoculation are accelerated pulse and leucocytosis. The important diagnostic signs, with history of case included, are prostration, evidences of toxemia, local crepitation and discoloration.

5. Gas bacillus infection, as shown by a survey of the literature and observance of a series of local cases, occurs as an important mortality factor in a great variety of clinical conditions. It is of great importance in cases involving compound fractures, puerperal infection, intestinal obstruction and peritonitis with ileus, gangrenous appendicitis and pelvic or abdominal contusions.

6. From the results of a search through the literature and from observation of a series of local cases presented, such bacteriological data point to *B. welchii* (*B. perfringens*) as the predominating causative organism found in the interesting variety of cases reported. It would appear from clinical reports that *B. welchii* may well be regarded as the important causative organism although frequently in association with various anaerobes and aerobes. Much careful work remains to be done on the bacteriology of gas gangrene.

7. Gas gangrene antitoxin, prepared from *B. welchii* and *Vibrio septique*, is indicated as a specific prophylactic treatment for all potential cases of gas bacillus infection and should be used early and freely as a specific curative agent in the treatment of all cases of gas gangrene. On the other hand, antitoxin should never be used as a substitute for surgery.

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THE TREATMENT OF EXTENSIVE GRANULATING AREAS

WITH SPECIAL REFERENCE TO THE USE OF PHYSICAL THERAPY MEASURES*

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IT is the object of this paper to outline a general plan for the treatment of extensive granulating surfaces resulting from burns, with special emphasis on some physical therapeutic measures used with advantage in conjunction with the surgical treatment.

The physical agents employed are ultra-violet radiation, heat producing radiation, warm brine and whirlpool baths, massage, passive motion and active exercise.

The patients under consideration are those suffering from burns involving more than 1000 cm.² of body surface, third degree burns for the most part, often with marked destruction of the subcutaneous tissues.

Some patients enter the hospital within a short time following the injury. In many instances, however, treatment of an indifferent nature has been carried out for some time prior to admission, the patient entering the hospital days or weeks after the burn.

In the group admitted to the hospital soon after the burn, the usual measures are directed toward supportive treatment. Opiates are given for relief of pain, and shock is treated by the general application of heat and by replacing the depleted body fluids. Glucose and normal saline also are given by hypodermoclysis and by intravenous administration. Transfusion is also used in some cases for relief of shock or for anemia accompanying severe sepsis. Bleeding and transfusion seem to be rather heroic treatment in these cases, although the usefulness of this form of treatment has not been conclusively disproved. All severe acute burns are treated by the tannic acid method as described by David-

son.¹ As soon as the crust separates off, the granulating area is prepared for skin grafting by the method described later on. Immersion of the patient in a warm bath has been abandoned, except as an aid in the removal of previously applied dressings of grease or sticky substances. Continued immersion may produce an undesirable weakening effect on a severely shocked patient.

The second group, with a considerable time elapsing following the burn, have survived the initial shock and toxemia and present the picture of severe sepsis dependent upon large infected granulating surfaces. The problem here is to prepare these large denuded areas so that skin grafts can soon be applied. It is obviously important that the majority of these grafts must be successful on the first trial, since the donor skin is limited in area because of the extent of the burn. Only autogenous grafts are used.

As soon as the general condition of the patient permits, all necrotic tissue is cut away and the surface carefully cleaned. Moist dressings of normal saline or boric acid are applied, and changed frequently enough to keep the surface free from exudate. In some cases a single layer of a perforated fabric laid directly on the burned area and covered with the moist gauze dressing adds materially to the patient's comfort. In children, particularly, this facilitates dressing because it prevents granulation tissue from growing into the interstices of the gauze and minimizes the discomfort caused by the removal of such dressings.

Continuous heat and ultraviolet radiation² are used in preparation of these

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wounds for skin grafting. The heat is obtained from an "oven baker" containing five tungsten filament bulbs, consum-

struction of the newly formed tissue is to be avoided. It is therefore necessary to learn the effect of a certain lamp upon the



FIG. 1. Light area shows heavy implantation on blood agar plate of *Staphylococcus aureus* and strain of hemolytic streptococcus from a burn. Dark circular area in lower left hand corner received quantity of ultraviolet radiation comparable to one-fifth of patient's erythema dose; the dark area at 9 o'clock received twice this quantity and the area at 11 o'clock three times the amount applied to the first area. Three-fifths of erythema dose inhibited all growth in this instance.

W. M. received third degree burns of both legs, admitted ten days after injury. Methods as described in this paper were used.

ing 25 to 60 watts of current per bulb. This apparatus is suspended from a rod extending longitudinally over the middle of the bed, so that it does not interfere with nursing care. A sheet partly surrounds the lamp and is folded under the mattress so that air currents are excluded. The temperature of the air surrounding the wounds is thus maintained at approximately 100°F. and the tissue temperature is not reduced by the wet dressings. Ultraviolet radiation is used in the preparation for skin grafting because it helps to decrease the amount of infection on the wound surface and aids in rapid formation of healthy granulation tissue.

Experience with other wounds has shown that care must be used in prescribing the amount of radiation administered if de-

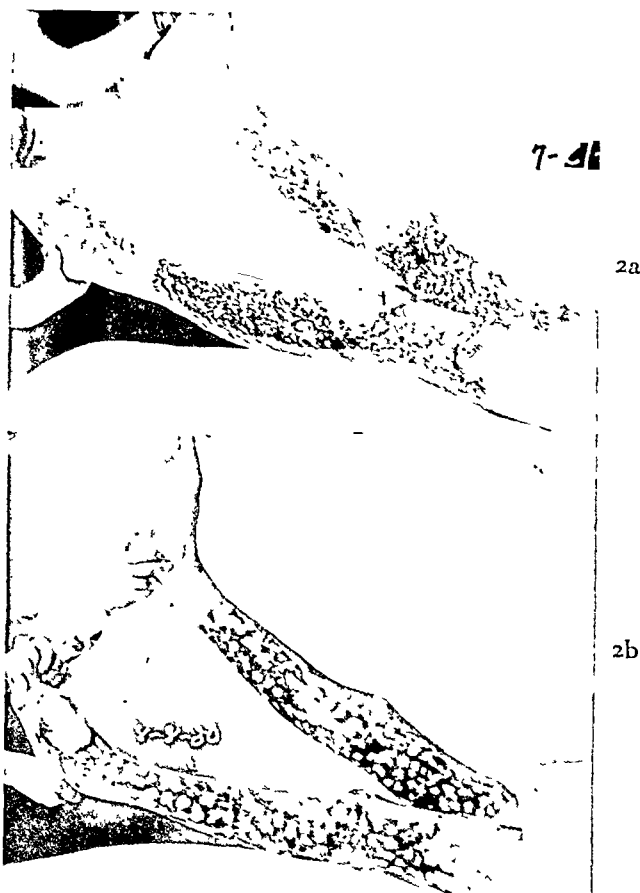


FIG. 2a. Healthy granulation tissue ready for skin grafting nineteen days after admission to hospital. Note exposed tendons on dorsum of left foot.

FIG. 2b. Grafts in place. Proliferation of epithelium has started from edges of grafts. Granulation tissue is clean. Grafting successful.

E. W. admitted to hospital two and one-half weeks after third degree burns of arms and legs. Patient in extremely toxic condition. Previously described method of preliminary treatment employed.

individual who is going to be treated. In the determination of dosage and during treatment of the patient the mercury arc lamps are operated at a potential of 70 volts and at a distance of 20 in. from the skin surface. The effectiveness of a particular lamp and the patient's skin sensitivity to the radiation are gauged by determining the length of exposure necessary to cause a standard intensity of erythema. This is done by exposing small areas of skin over the scapular region for different lengths of time; the first distinct

homogenous redness resulting from the shortest exposure represents a skin erythema dose. It is impossible to prescribe a

measured in terms of the patient's erythema reaction, and the plate incubated for twenty-four hours (Fig. 1). From this



FIG. 3a. Condition of wounds twenty-six days after admission. Soon after this photograph was made, large full thickness grafts were applied.

dose in minutes and distance which will be satisfactory because different mercury or carbon arcs may require different lengths of exposure at the same distance from the patient to produce the same effect.

It is found that in severely infected wounds the best results are accomplished by an initial exposure equal to 100 to 150 per cent of the erythema dose. The second and third treatments should usually be decreased in intensity and further radiation administered in doses of about 70 per cent of the erythema time. Within a period of about two weeks, after daily treatment of this type is instituted, the wounds are usually ready for skin grafting.

By the use of this small dosage, sufficient bactericidal effect is gained without injuring the newly formed tissue. This was substantiated by a determination of the length of time required to kill bacteria when placed on culture media. The test was performed by inoculating a blood agar plate with a suspension of material taken from the surface of a patient's wound. Small areas of the plate were then exposed to quantities of ultraviolet radiation,

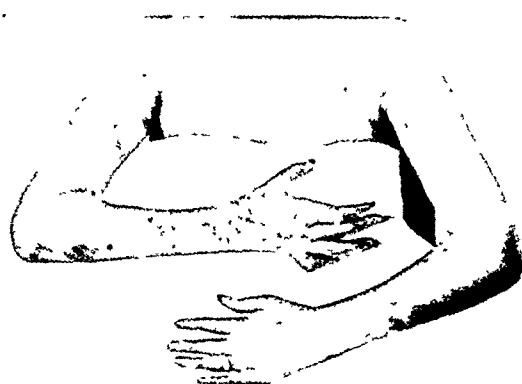


FIG. 3b. Patient one and one-half months after first grafts were started.

J. H. admitted to hospital four weeks after third degree burns of back and right leg. Grafts placed on burned area over scapular region four days after admission, since granulation tissue appeared healthy. Many of these failed to grow. Ultraviolet radiation then started; within seven days grafts reapplied to granulating area.

test it appears that less than 70 per cent of a skin erythema dose was sufficient to cause destruction of the organisms on the surface. Clinically, the laboratory test was substantiated by the rapid disappearance of much of the infection, although the wounds were never entirely free from bacteria.

Large Ollier-Thiersch grafts are used in most cases, except where there is a very limited area of donor skin available. In such cases either small Thiersch grafts or small deep grafts are employed, placed some distance apart, or larger grafts are cut into smaller pieces and similarly placed. These form separate epithelial islands in the same manner as pinch grafts.

In most cases no dressing is used on the freshly applied grafts, except a very small amount of sterile vaseline or liquid petrolatum at the borders of the grafts to prevent drying and curling. This forms an excellent method for large isolated Ollier-Thiersch grafts taken in a single piece, because it allows scrutiny of the grafts

from the start. The use of a wire cradle over the freshly grafted area, with sand bags to immobilize the part, gives protec-

per cent tannic acid, as in a fresh burn, forms a very satisfactory dressing, preferable to those of gauze, either dry, moist



FIG. 4a. Proliferation of epithelium from grafts two weeks after grafting.

tion against brushing of the grafts by the bed clothes. Any collection of serum under the grafts, which might interfere with its taking, is rolled out with an applicator, and small crusts at the edges are picked off two or three times daily. In our experience this exposure to the air is superior to many other forms of dressings which are in use, since it is simple, comfortable to the patient, and makes the area readily accessible to treatment. When this method is employed, moist gauze dressings are generally applied for short periods after the fourth or fifth day to facilitate removal of desquamation from the graft.

In children, and when it is desirable to cover the newly applied Ollier-Thiersch grafts, paraffin may be sprayed over the grafts, and this covered with shingled strips of gutta percha, as described by Coller.³ A perforated fabric may also be used, covering this with warm moist gauze dressings. These dressings may be removed easily without disturbing the grafts and with no discomfort to the patient.

Immediately after operation the donor area is frequently more uncomfortable than the burned area, particularly when thick grafts have been removed because a large portion of the corium is taken. We have found that covering this area with 4



FIG. 4b. Area thirty days after grafting.

or greasy. The area from which the graft has been removed is sprayed every hour with a 4 per cent tannic acid solution from a common atomizer until a thick leathery crust forms. This occurs after two or three applications and gives a covering which is entirely comfortable and needs no further attention. Within ten days or two weeks the crust will separate spontaneously as the epidermis regenerates.

Ultraviolet radiation is often restarted within three to six days after operation, in order to prevent the development of marked infection and to produce a mild active hyperemia of the graft. If considerable space has to be left between the grafts, a perforated fabric and normal saline dressings may be used. In cases such as this it was observed that with radiation and these dressings the infection was not only held at a minimum, but there was a rapid spread of epithelial tissue from the grafts. The rate of tissue proliferation was frequently as great as 1 mm. in twenty-four hours. However, when the granulating surface is covered with any oily substance ultraviolet radiation is not used because it will not penetrate the vaseline over the margins of the graft in a sufficient amount to be of benefit.

From this experience and that gained in the treatment of other lesions it appears that the effect of ultraviolet radiation on these

wounds may be attributed to the following factors: first, a bactericidal effect upon the surface organisms; second, production of an active hyperemia which increases nutrition and local bactericidal action; third, perhaps a stimulation of cell growth.

During the time when the patients are being prepared for skin grafting, measures must be taken to prevent contractures. Whenever possible the joints should be moved through their full range at least once a day. If the patient can do this himself he should exercise under supervision, but if unable to do so, passive motion is necessary.⁴ Proper splinting is also essential in preventing contractures.

When the surface is covered with epithelium, massage is started and the amount of motion increased. Brine (2 to 4 per cent) is employed as a media in which the patient exercises the injured parts. In this a greater range of motion can be gained with minimum muscular effort because the action of gravity is diminished by the buoyant effect of the salt water. Whirlpool baths are also used because of the buoyant effects of water, the heat gained from the bath and the stimulation of the superficial circulatory system.

At the same time that massage is begun the patient is given various interesting and useful occupational exercises. These assist in the development of function and coordination, without directing the patient's attention toward the injured condition. Checkers, letter writing, modeling clay and basketry are useful forms of therapeutic exercise for patients who have limitation of motion in the hands. The exercise of boring a hole, hammering nails, or using a screw driver encourages active use of the upper extremities, while sawing boards, tossing or kicking a ball will influence both the upper and lower extremi-

ties. When therapeutic exercise is prescribed the patient must be instructed in the particular method of performing the task which will call the disabled muscles into play. Otherwise the patient is apt to use the part in an abnormal manner and the desired effect will not be obtained.

SUMMARY

1. Physical therapy measures are of distinct value to the surgeon in the treatment of extensive body burns.
2. Ultraviolet radiation acts as a superficial bactericidal agent on infected granulating surfaces and in this manner assists in the preparation for skin grafts.
3. A mild active hyperemia is produced, and possibly a stimulation to cell growth, by ultraviolet radiation.
4. Ollier-Thiersch or split thickness grafts form a satisfactory means of covering these large denuded areas.
5. The open air treatment of freshly applied Ollier-Thiersch grafts is advisable in some instances.
6. The donor site is comfortably dressed by the application of tannic acid.
7. The length of exposure of the wound is dependent upon the intensity of the source of radiation, the distance from the source to the lesion and the erythema response of the individual.
8. Three-quarters of an erythema dose will kill bacteria on the surface, produce a mild local active hyperemia and stimulate cell growth.
9. Early active motion even before skin grafting is often essential for maintenance and restoration of joint function.
10. Therapeutic exercise should be prescribed and supervised so that definite groups of muscles are exercised and the patient's attention drawn away from the disabled member.

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RUPTURE OF THE BLADDER THROUGH HUNNER ULCER-BEARING AREA*

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CASE 1. patient, Mr. W. E., a negro, presents a very unusual history and course. He states that he had noted frequency of urination for some time prior to 1915, at which time there were no other symptoms referable to the urinary tract. In 1915 he contracted a Neisserian infection and received treatment for two weeks. Following this episode he stated that he felt better but that after entering the Army in 1917 and drilling considerably he noted a reappearance of urinary frequency and again received some kind of treatment for it. The frequency was eventually accompanied by dysuria and urgency. He has never noticed the passage of blood or foreign bodies.

His past history revealed typhoid fever in 1915, an operation for appendicitis in 1919, which was complicated by a postoperative pneumonia.

Examination of the Genitourinary Tract: Palpation of both kidney and bladder regions was negative. Rectal examination revealed a normal prostate. The expressed fluid was negative for pathologic elements. The seminal vesicles were not palpable. A No. 26 bougie à boule was passed and no stricture of the urethra was found, while a No. 26 sound passed readily into the bladder. The urine was crystal-line clear but on centrifuging an occasional red blood cell was found.

Cystoscopic examination revealed a markedly reduced bladder capacity; 90 to 100 c.c. were the limit of tolerance. The bladder throughout was normal except for a small area which was typical for a so-called Hunner ulcer. As the bladder was distended, minute droplets of blood were seen to be coming from this defect. This "ulcer" appeared more as a fissure than an actual loss of substance. The ureteral orifices were normal in appearance.

A specimen of urine was sent to the laboratory to be examined for tubercle bacilli and for guinea-pig inoculation. These results were entirely negative.

The treatment of this patient brought up several extremely interesting points. We had no demonstrable etiological factors in the causation of this lesion in this patient. All foci which were removable were surgically cared for, his tonsils were removed and all diseased and suspicious appearing teeth likewise were extracted. There was no change in the clinical symptoms after these procedures. Foreign proteins were injected, likewise, with negative results. Mercurochrome was given intravenously repeatedly, after which there was a definite improvement in the dysuria and urinary calls were reduced fully one-half. This amelioration continued up to a certain point and then became stationary. Fulguration of the defect was advised and done without improvement on three different occasions. Forced dilatation under gas anesthesia, as recommended by some authors, was done.

Shortly following the fifth or sixth of these dilatations under gas anesthesia, the patient developed a boggy mass in the abdomen above the symphysis pubis. This was associated with considerable pain and bladder tenesmus. There was only a very slight elevation of temperature. Fifteen days thereafter he developed an acute retention of urine and the following day was cystoscoped; what was apparently an organized blood clot was washed out through the cystoscope. This proved, however, to be necrotic bladder tissue. After the filling fluid was again quite clear, a ragged tear was seen near the dome of the bladder, occupying the exact location of the defect first noted. He was, therefore, taken to the x-ray department and a cystogram was made (Fig. 1). The cystogram revealed a very large irregular shadow ventral to the bladder shadow which was a diverticulum of the bladder produced by the forcible dilatation done fifteen days before. The diagnosis, was rupture of the bladder causing pseudo-diverticulum.

Under spinal anesthesia, a midline incision from the symphysis pubis extending upward

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for about 4 in. was made. The bladder was exposed in the usual manner and then opened longitudinally. A finger was inserted in the

through an area of chronically inflamed tissue now appears too likely. It is a procedure which we will not attempt again.



FIG. 1.



FIG. 2.

bladder and the opening of the pseudo-diverticulum located. The right lateral wall of the bladder was then dissected free until the pseudo-diverticulum was opened. An incision was made in the bladder wall down to the opening of the diverticulum. The diverticulum was removed and the edges closed with No. 1 chromic catgut. The midline incision in the bladder was closed in layers about a suprapubic tube. Two Penrose drains were let down to the site of the diverticulum in the deeper structures. There was considerable induration noted at the site of the diverticulum resulting from the escape of urine.

The patient made an uneventful recovery. At the present time his urinary calls are less frequent than they have at any time since his admittance to the hospital and are definitely improved over the condition noted after the mercurochrome injections given intravenously.

This case illustrates that all the so-called orthodox therapeutic measures are without result. The use of mercurochrome intravenously, based purely on an empirical conception, afforded some improvement. The forced dilatation of the bladder, as recommended by many, seems in view of the unpleasant results obtained in this case to be definitely contraindicated and the possibility of rupture of the bladder

The conception of certain men that resection is the only logical treatment seems in a manner to be borne out by this case. However, should we have the opportunity of seeing another case of similar character, we shall content ourselves at first at least with a freeing and complete mobilization of the bladder. It seems likely in this case that the real result of the last operation done may be due almost entirely to the freeing of the bladder from contiguous structures.

CALCULUS IN URETER AND URINARY FISTULA

Case 11. A patient entered the hospital with a diagnosis of urinary fistula in the right loin. He stated that for years he had been having periodic attacks of pain simulating renal colic, always on the right side. About five weeks before entrance he was operated upon. An attempt was made to remove a stone. After the operation his surgeon told him that he was unable to locate the stone. Since operation, urine had been draining from a sinus in the operative incision. With the exception of this continuous leakage of urine through the loin there were no other symptoms present.

His past history was entirely negative except for Neisserian infection in 1918, which permanently cleared up within a few weeks recurrence.

Examination: There was a sinus in the middle of an otherwise well healed oblique kidney incision in the right loin which was draining clear urine. The left kidney region was negative as was the bladder region. The genitals were negative. There was no adenopathy. The urine voided by the urethra was cloudy and many leucocytes were found. The prostate was normal to palpation and the expressed fluid was negative. The seminal vesicles were not palpable.

Cystoscopic Examination: A No. 21 Brown-Buerger cystoscope was passed into the bladder without obstruction. The bladder vault was normal in appearance as was the trigone but there were several small masses of crystalline debris lying on it. Both ureteral orifices were normal. No. 6 catheter passed readily to the pelvis of the left kidney, but a similar catheter met obstruction in the right ureter, 15 cm. above the orifice. It could not be passed beyond this obstruction nor could the smallest ureteral bougie. Pyelograms were made showing a slightly dilated left pelvis with a kink in the ureter at about the level of the middle of the sacroiliac junction. No shadow was visible in the region of the right pelvis because it was impossible to inject fluid above the point of obstruction. There was, however, the shadow of an opaque object, shaped like a collar button, with the broad end directed upwards.

The diagnosis at this time was calculus in the upper third of the right ureter and urinary fistula.

Various attempts were made to manipulate this calculus through the ureter by means of dilatation and injections of oil. After one of these dilatations, the patient reported a very severe kidney colic on the right side and almost immediately thereafter the urinary fistula in the loin began to heal. However, no stone was passed with the urine. Ten days after this severe kidney colic, a flat plate failed to reveal any stone shadow. Fourteen days thereafter, a No. 11 bougie was passed to the pelvis of the right kidney without difficulty. The cystoscopic picture had not changed. The patient still continued to have occasional dilatations of the right ureter and the pyelogram then made showed a moderate degree of hydronephrosis on the right side.

Examination made twenty-eight days after the severe renal colic previously mentioned showed that the urinary fistula had entirely

healed. The patient felt very well and, except for the presence of the hydronephrosis on the right side which was injected and the presence

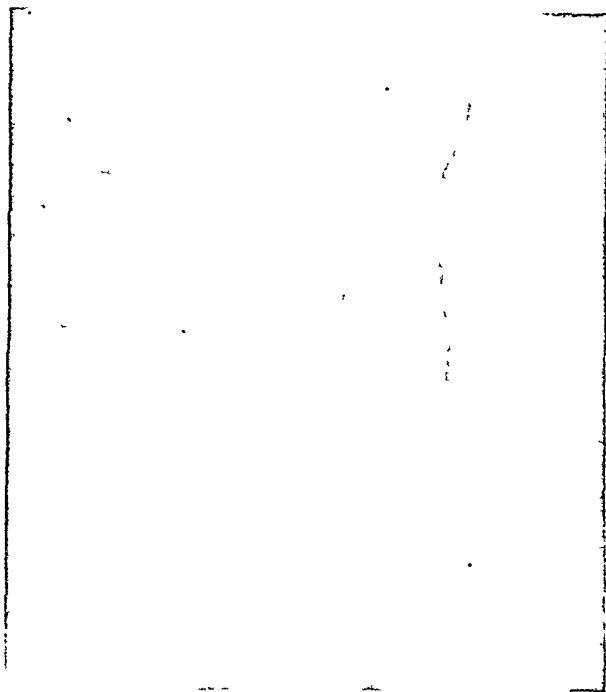


FIG. 3. Calculus in ureter.

of two definite strictures noted in the course of the right ureter, he was to all intents and purposes quite well. He thereupon demanded his discharge from the hospital, which was granted. The patient has since remained in excellent health and is having from time to time dilatations of the right ureter. About two months after the healing of his urinary fistula we were rewarded by having the patient pass a calculus which conformed in all characteristics to the shadow seen at the upper third of the right ureter when he entered the hospital.

This case is exceptional, first, in that the stone was not located at surgical operation, and secondly, in showing what might be expected with conservative treatment of urinary calculus. We generally make every attempt not to open the ureter in its continuity, feeling that stones which must be removed surgically from the upper third of the ureter can usually be made to enter the pelvis of the kidney by manipulation even at the time of operation and that pyelotomy incision is much safer than an incision into the ureter itself.

THE PREVENTION OF INFECTIONS IN PROSTATECTOMY

A PRELIMINARY REPORT ON THE USE OF MERCUROCHROME*

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THE presentation of this paper was stimulated for two reasons. The first was that, during the past two years, several cases of urosepsis of various types associated with prostatism came under my observation. Only recently a severe and fatal form of sepsis followed prostatectomy, performed under excellent conditions by a competent colleague in urology. Other cases of phlebitis, septic pneumonia, and persistent irregular temperatures, without physical signs to explain them, have occurred. Some of these followed cystotomy, others followed the second stage.

The second reason for offering a new idea in aseptic technique was the appearance of frequent recent publications concerning the prevention of infections in prostatectomy. This indicates the need for further measures in controlling infections. Numerous papers have appeared on prevesical space puncture and also specialized technique of cystotomy to prevent wound contamination. As far as a three-step operation is concerned, free drainage of the prevesical space, at the time of cystotomy, would appear to be sufficient to prevent "pocketing" and possible secondary infection in this area. My own experience leads me to the conclusion that a two-stage operation with drainage is fully sufficient. In considering the various factors of infection, there is a practical point of importance which has heretofore received little or no attention. Recall for a moment the large space remaining after gland enucleation with its open raw surface and exposure of vessels and lymphatic spaces. This matter deserves further consideration. It will no doubt be agreed that every bladder

containing a suprapubic or urethral rubber tube is either infected or potentially so. Is it any wonder that pelvic cellulitis, pericystitis, phlebitis and the varied forms of urosepsis occur as a complication in a certain percentage of cases starting in the prostatic bed? Dr. E. L. Keyes believes that at least some of these infections are primarily prostatic rather than vesical or prevesical.

Apropos of these remarks, I have been using a 2 per cent solution of acetone-alcohol-mercurochrome for its penetrating sterilizing effects. If this method has been applied before, I am not aware of it. The solution is poured into the bladder and prostatic pouch as soon after gland enucleation as hemorrhage is temporarily controlled. This is given a little time to soak before the insertion of a hemostatic bag or pack, if either of these is found necessary. In about 25 per cent to 30 per cent of cases, all performed under spinal anesthesia, a suture or a few sutures will eliminate the necessity for a bag or pack which only acts as a foreign body and tends to invite complicating infection. After more than three years' use of the mercurochrome solution, I have found that secondary complicating infection has not occurred, other than slight infections about the drainage tube. In going over the charts of 65 cases, all done by the suprapubic route, I find no evidence of septic complication or of continued irregular temperature after operation. In an equal series of cases where mercurochrome was not employed, I have noted a not infrequent tendency to persistence of temperature, with and without other symptoms of sepsis. With the mercurochrome technique moderate febrile reac-

* Read before the Brooklyn Urological Society, April 14, 1931.

tions lasting two to four days were the rule after both first and second stage operations. A few were practically afebrile. Fever very rarely persisted for seven or eight days. In one notable exception the temperature ran active for one week and low grade for two weeks thereafter without other complication. In this instance the suprapubic wound was very slow in closing and the retention drainage catheter was not successful. (Considerable caution must always be used in the use of self-retaining catheters.) A small number of the patients had severe chill and high fever and sweat after operation which usually passed in twenty-four hours. This reaction occurred more frequently after the second stage than the first. In 4 cases where this severe reaction occurred after cystotomy, at the second stage there was almost no febrile reaction. I am therefore impressed with its possibilities for the future, if widely used, in reducing the incidence of infective complications. When the urethral catheter is passed for the first time the bladder is usually found to be much cleaner than without its use.

I fully appreciate the occurrence of these infections both before and after cystotomy, also that some have a badly infected bladder before drainage is performed. In fact, some of the severest and most lasting febrile reactions follow simple cystotomy. In these we also inject 3 to 4 oz. of 2 per cent acetone-alcohol-mercurochrome solution into the bladder if the bladder is anesthetized. The acetone-alcohol solution is also poured into the prevesical space, or to the side of the bladder if a space is left for drainage, and excess of solution sponged away after soaking for a few minutes. If the bladder is not anesthetized, it is filled with 2 per cent aqueous solution. I am now using 1 to 2 oz. of a 1 per cent aqueous solution injected into the bladder twice a day for three days, both before and after the first and second stage operations. (A 0.5 per cent aqueous solution can be instilled and retained for a time through the indwelling

urethral catheter if one does not do the two-stage operation as a routine.)

We have noted also the not infrequent sharp rise of temperature usually of short duration following the passage of a catheter or sound for the first time (after prostatectomy). I feel that caution and gentleness will minimize this reaction and that instruments passed on the ninth or tenth day are less likely to produce temperature than when used sooner. When the alcohol-acetone-mercurochrome solution is poured into the bladder, it undoubtedly destroys all or most of the pathogenic bacteria or inhibits them for a sufficient length of time to allow the tissue defense mechanism and protective leucocytic zones to be established. It, furthermore, has a mild but distinct hemostatic action. It seems logical also that this could be used in the same manner in any deep wounds about the kidney, ureter or bladder where contamination with infected urine or pus is frequently encountered. It should materially aid in reducing secondary deep wound infections. The alcohol-acetone-mercurochrome brought out by Dr. H. H. Young and his co-workers has proved eminently satisfactory for preparation of the skin before operation. It has the distinct advantage over iodine of not burning the skin of the genitalia. The persistence of the dye in the skin for five to ten days after operation is proof of its penetrating power.

The rationale of using mercurochrome in prostatectomy is based upon the proved success of its use in childbirth and in cesarian section. This has been the subject of creditable comment by the *Journal of the American Medical Association*. The striking results of Dr. H. W. Mayes¹ after more than six years use in many thousands of cases are convincing.

Just as obstetric cases, after vaginal examinations, are considered potentially infected, so must the bladder or prostate be considered after catheterization or

¹ Mayes, H. W. The use of mercurochrome as a vaginal antiseptic before cesarean section. *Am. J. Obst. Gynec.*, 17: 5, 645, 1929.

cystotomy for urinary retention. The writer feels that one must find some analogy between the uterine cavity, cervix and vagina, and that of the bladder, prostate and urethra. It is interesting to note that Dr. Mayes¹ routinely pours 1 oz. of 4 per cent aqueous solution into the uterine cavity after cesarian section and removal of the placenta, in addition to preliminary instillation of the vagina with the same solution. Reduction in morbidity and mortality has been impressive. Moreover, positive cultures from the vagina were reduced from 44 per cent to 6 per cent, from the cervix 16 per cent to 4 per cent, and from membranes 32 per cent to 6.4 per cent. It is worthy of note that bacteria are killed in one hour by mercurochrome in 'dilution of $\frac{1}{1000}$ in amniotic fluid.

While I have not used the method extensively enough to draw definite conclusions from it, I am impressed with clinical results. It appears likely that its wider use may prove its value in materially reducing complicating infections in cystotomy and prostatectomy for the relief of prostatic obstruction. We believe that, in the future, the use of penetrating antiseptics may come to occupy a definite place in reducing the incidence of these infections, thereby reducing morbidity, delayed convalescence, and even mortality.

The following statement by the manufacturer of mercurochrome is impressive:

As has been demonstrated by reference to the medical literature, mercurochrome has proved to be relatively non-irritating and non-destructive of body cells. Its penetration is

deep and it is, moreover, very active against bacteria. More important, however, is the fact that it remains in the tissues, in spite of exudates and lavage, in sufficient strength to prevent the growth of any organisms which may find their way into the wound subsequent to the original injury or operation, and also that it inhibits and finally kills very resistant bacteria.

We present these ideas for your further consideration and application.

TECHNIQUE

The following routine is recommended:

1. *At cystotomy:* Fill bladder and pre-vesical space with 2 per cent acetone-alcohol-mercurochrome solution, if bladder is anesthetized. Use 2 per cent aqueous solution if not anesthetized. After a few minutes the excess of solution is sponged away.

2. *At prostatectomy:* Fill bladder and prostatic bed with 2 per cent alcohol-acetone-mercurochrome solution, also fill any space left in front or to the side of bladder. After a few minutes, excess of solution is sponged away.

3. *Preoperative and postoperative:* Instill 1 to 2 oz. of 1 per cent aqueous solution through suprapubic tube twice a day for three days after cystotomy, also for three days before and three days after prostatectomy.

Instill 0.5 per cent aqueous solution into infected bladder before cystotomy.

Use 0.5 per cent aqueous solution twice a day for three or more days before operation in patients wearing the preliminary urethral retention catheter.

(Nos. 1 and 2 are most essential. We have carried out No. 3 in a few of the later cases.)

¹ Mayes, H. W. A bacteriological study of the value of mercurochrome as a vaginal antiseptic with particular reference to its use in obstetrical cases. *Surg. Gynec. Obst.*, 51: 345-352, 1930.



PLASTIC SURGERY AND THE SPECIALISTS*

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THE establishment of plastic surgery services in teaching institutions and general hospitals is a comparatively recent occurrence, on which much of the future development of this specialty depends. This was not accomplished however, without opposition from certain medical groups, which considered plastic surgery not as an independent unit, but as a work to be included in the hitherto recognized surgical sections. Any new trend in medicine or surgery is apt to meet with some opposition, at least in the beginning, due largely to the lack of comprehension, and also to the natural reaction of those engaged in other specialties, who fear encroachment. However, in the interest of surgical advancement, as well as for the benefit of the patients, these objections must be disregarded.

The purpose of this paper is to shed light on the important indications for plastic and reconstructive surgery and its relationship to other surgical and medical specialties.

The status of plastic surgery in most general hospitals is as yet undetermined. In some hospitals this specialty is organized as an independent service, in others it is connected with oral surgery or rhinolaryngology; in many institutions the medical boards do not yet realize the necessity for this special service. Thus in each instance the medical staff renders its own interpretation on this subject. It is obvious that the sound development of a specialty is possible only when left to its normal boundaries and not hampered by arbitrary restrictions.

A great number of conditions require plastic repair and it is evident that this surgery should be duly represented among the other specialties in any modern hospital.

EMERGENCY REPAIR IN RECENT WOUNDS

Recent injuries of the exposed parts of the body do not always receive the attention they require with a view to the prevention of deformities and preservation of function.

The National Safety Council reports over 97,000 deaths in this country in 1929 due to accidents of all kinds and 31,500 deaths due to automobile accidents alone.¹ The Department of Commerce reported 23,000 deaths from industrial accidents in the United States in 1929, 3,000,000 injuries and a money loss totaling \$1,000,000,000 as the result of such accidents.² This unusually high accident and death rate calls for serious consideration. A thorough emergency repair of these injuries will go far in the prevention of conspicuous deformities and in the reduction of a great economic waste.

Severe automobile injuries are usually seen first in the emergency room of a general hospital; industrial accidents are generally taken care of in clinics maintained by insurance companies. The vast number of highway and industrial accidents in this country in itself justifies the establishment of appropriate facilities in general hospitals for the care of these cases.

The importance of a thorough early repair must be properly estimated; hematoma, infection and inaccurate adjustment of tissues will result in a prolonged healing process with undue scar formation, deformities and disturbance of function. The healing process of a properly treated wound which requires at most a few weeks, if given inadequate first aid, may drag on for months and even years, thus causing unnecessary suffering and economic waste³ (Fig. 1).

* Submitted for publication April 22, 1931.

Emergency surgery in extensive lacerations of soft tissues, particularly those of the face and neck should not be left to the

Post-traumatic repair of soft tissues performed without haste in a properly equipped operating room with the use of



FIG. 1. Male, aged twenty-eight, showing condition of face three weeks after injury sustained in elevator crash. I was called to see the injured who was treated in a municipal hospital, three weeks after the accident, during which time no repair had been attempted. Seven plastic operations were required for the repair of the nose, eyelids, cheeks and lips and for the relief of nasal obstruction. A great economic loss as well as suffering might have been avoided if proper emergency repair, consisting in the immediate readjustment of the displaced structures had been carried out. (The surgical repair of this case is described by me elsewhere.*)

interne, as is usually the case, but should be done under the supervision of a competent plastic surgeon. If the accident occurred several hours before the injured is brought to the hospital and under unfavorable aseptic circumstances, it is safer to disinfect the wound and postpone the surgical repair for from twenty-four to forty-eight hours, when the culture of the wound proves negative. The application of moist and warm dressings and the liberal use of Dakin's solution are of great help in bringing about a thorough disinfection.

* Maliniak, J. W. Important factors in surgery of congenital and acquired facial deformities. To be published in the *New Jersey State M. J.* Read at the Annual Meeting, N. J. State Med. Soc., June, 1931.

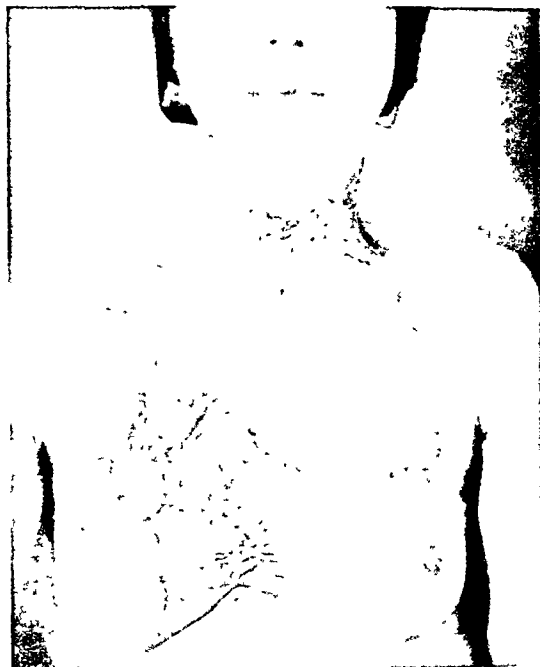


FIG. 2. Female, aged twenty-five, presenting extensive scarring of neck and chin caused by burn sustained at age of two years. Numerous unsuccessful attempts to correct deformity made elsewhere. Scarring of right breast is caused by Thiersch grafting of area from which full thickness flap was transferred to neck. Patient shows marked tendency to keloids. Tubed skin flap on back was prepared by me to provide covering for left side of neck after excision of remaining scars. This will require several stages.

fine suture material and without undue tension will provide a far more satisfactory end-result than that obtained by immediate repair in the emergency room.

LATE REPAIR OF WOUNDS

Burns and motor accidents cause the largest group of acquired disfigurements. The management of burns resolves itself into a real problem, as it requires the most painstaking and elaborate reconstructive procedures. A satisfactory esthetic and functional restoration of the burned area is essential, as the end-result will naturally affect the function of the involved part as well as the professional and social status of the patient. Wounds exposing

nerves, tendons and joints require a more adequate protection, which is provided by pedicled flaps from the vicinity, or by

The possibility of reconstruction of large defects following cancer surgery, especially in the maxillofacial area will encourage a



FIG. 3A

FIG. 3B

FIG. 3. Reconstruction of highly hypertrophic ptosed breasts in multipara aged thirty-one. Patient suffered from dragging sensation around shoulders and pain in chest, caused by weight of breast. Hypertrophy of breasts out of proportion with slenderness of body. Marked mental depression present. Reconstruction of breast done by method of subcutaneous transposition of gland, resection of fat tissue and mastopexy to pectoral fascia. Scars in submammary fold and around nipple are inconspicuous.

free full-thickness grafts. When the involved parts do not interfere with an important function, a thick Thiersch graft will suffice as a covering. The esthetic aspect in the restoration of facial burns is of paramount importance and requires a skin graft which matches the surrounding area in texture and color; a pedicled skin flap may not be available, and if so additional scarring is added; full thickness grafts show a great tendency "to take" on the forehead, but are prone to failure if applied on the cheek and neck where complete immobilization of the region is more difficult.

A pronounced tendency to contraction is shown by thin skin grafts and this is to be considered in connection with their use in wounds around the facial cavities and neck. The choice of the type of skin required should be uppermost in the mind of the surgeon who attempts this type of repair (Fig. 2).

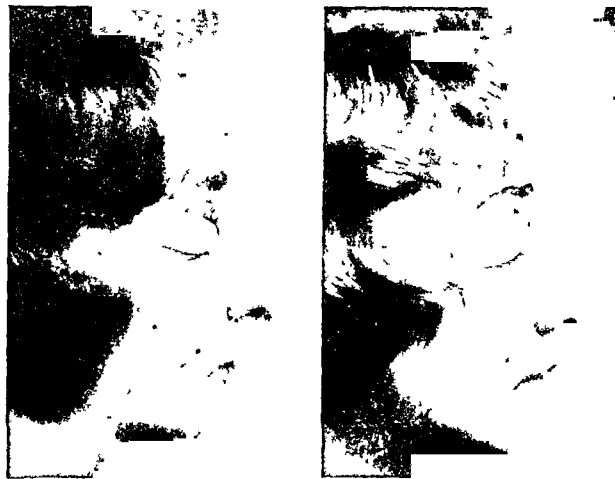


FIG. 4A

Before

FIG. 4B

After

FIG. 4. Nasal reconstruction for excessive length of nose with convex profile and hanging columella. Correction done under local anesthesia by endonasal route. Unesthetic disproportion between high forehead and short chin disappeared by proper shortening of nose: marked improvement in facial contour due to nasal reconstruction as well as to relief from psychic depression.

more complete eradication of the disease and thus further the chances of cure.

PLASTIC REPAIR OF PENDULOUS, HYPERTROPHIC AND ATROPHIC BREASTS

This phase of reconstructive surgery has been until recently, largely neglected. Indications for this surgery are many and criticisms on the part of those unfamiliar with this subject, groundless. A review of the literature of the past two decades reveals the great interest shown in this subject by leading European surgeons. The names of Morestin,⁴ Lexer,⁵ Joseph,⁶ Dartigues,⁷ are closely connected with the surgical procedures described for the relief of this condition, and are of sufficient weight to warrant greater interest on the part of the medical profession. On several occasions the writer has operated upon patients with highly ptosed hypertrophic breasts, who were previously advised to have their breasts amputated; a breast plastic operation in these cases not

only spared the patients the horror of amputation but restored the contour of the breast and its normal topography. The

The correction of congenital and acquired nasal deformities done with proper skill and strict asepsis should uniformly



FIG. 5A

FIG. 5B

FIG. 5C

FIG. 5. A. Loss of both alae nasi and greater part of nasal covering resulting from galvanocauterization of rhinophyma done elsewhere. B. Tubed temporal flap, previously delayed, used for nasal covering. Lining provided by nasal skin secured from above the defect. Forehead repaired by repeated excisions of scar area. C. Final result after returning pedicle to forehead.

surgical procedure of choice for the correction of hypertrophic and atrophic prolapsed breasts has been fully described by me in a separate paper⁸ (Fig. 3).

PLASTIC REPAIR IN OTORHINOLARYNGOLOGY

A rhinologist does not always possess the necessary skill and artistic inclination essential for the successful performance of rhinoplasties and otoplasties, which are the most common indications in otorhinolaryngology. Rhinological as well as general surgical training is essential for this surgery, in addition to which a fully developed sense of proportion and harmony is a prime requisite. The rhinologist usually does not receive the strict aseptical training of the general surgeon and aseptic facilities are often lacking in a nose and throat operating room. The association of plastic surgery with the rhinolaryngological service in a general hospital is therefore entirely out of place. In addition to rhinoplasties (corrective, partial and total), plastic repair is indicated in atrophic rhinitis,⁹ narrowing of nasal cavities by transplantation of cartilage into the septum and floor of the nose, in nasal atresias, etc. Other indications are the closure of large defects following mastoidectomies, tracheotomies, etc., and otoplasties.

be followed by a satisfactory functional and esthetic end-result (Fig. 4). Any factors which may endanger the surgical procedure such as general anesthesia, endonasal or paranasal infections, lues, etc., should be carefully eliminated. The vital importance of partial or total nasal reconstruction can be fully appreciated only by those who frequently deal with patients requiring this surgery (Fig. 5).

While partial ear reconstruction is comparatively easy, the end-results in total otoplasty leave much room for improvement.

PLASTIC REPAIR IN OPHTHALMOLOGY

Surgery of paraorbital, congenital and acquired deformities is of vital importance as it usually aims not only to correct the disfigurement, but especially to reestablish the functional disturbances. The majority of ophthalmologists do not perform plastic operations around the orbital region, but some of them practice this surgery with great skill and have contributed much to its development.¹⁰ The most common indications for plastic repair in this field consist of cicatricial contractions around the eyelids and eye sockets due to mechanical injuries, and burns.

Shifting of skin flaps from the vicinity and the use of free skin grafts meet with far greater difficulties here than in any

the repair of a cleft lip deformity is of such precision as to preclude the possibility of further failures in this surgery. In the



FIG. 6. Female aged twenty-five. Showing condition twenty-four years after six unsuccessful attempts to repair unilateral cleft lip and cleft palate; note pronounced scarring, flattening and shortness of lip, absence of vermillion border and deformity of right nostril. Plastic repair of this condition would require total reconstruction of lip by two pedicled flaps from lower part of cheeks, indication for which in this case seemed questionable. Palate was inoperable.

other part of the body because of the different varieties of skin covering which comprise this region and their functional importance. A thick skin graft for the forehead, hair bearing skin for the eyebrow and a graft of fine texture for the eyelids must be used to obtain a satisfactory anatomical and functional restoration of this area.

ORAL SURGERY: CLEFT LIP AND CLEFT PALATE

Notwithstanding the progress made in this surgery during the last decade, we still too often see end-results in cleft lip and cleft palate operations which leave much to be desired from functional and esthetic points of view (Fig. 6). The surgical technique at our disposal today for

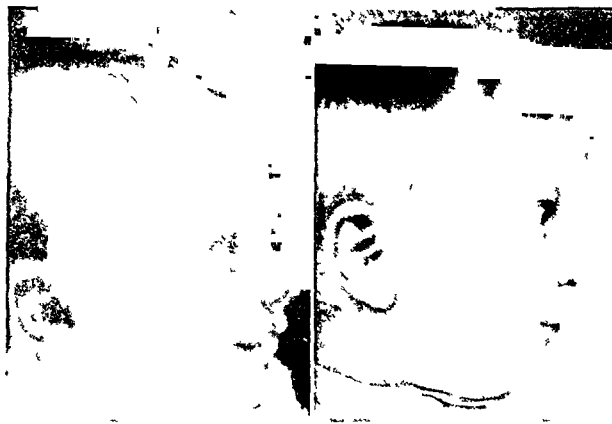


FIG. 7A

FIG. 7B

FIG. 7. A. Incomplete unilateral cleft lip repaired at age of six weeks. B. Condition of lip at age of eight months. Length and thickness of lip as well as continuity of vermillion border altogether normal; flattened right nostril corrected at same time.

more complicated types of double cleft lip and cleft palate, satisfactory end-results can be expected if this surgery is done in successive stages.¹¹ The general principles of reconstructive surgery are to be applied here as in other large skin defects: the proper outlining of flaps provided with adequate blood supply, sufficient undermining of the surrounding skin and mucous membrane, avoidance of tension, and the use of fine suture material are the deciding factors which make for a successful end-result (Fig. 7). The necessity for an early operation of cleft lip, four to five weeks after birth, and the closure of the palate at the age of from twelve to eighteen months is to be strongly impressed upon the mind of the obstetrician and pediatrician. Early and competent speech training in young children is required to assure a good functional result without which even the most successfully closed palate is a partial failure.

PLASTIC REPAIR IN DERMATOLOGY

The application of plastic surgery procedures is of untold value in dermatological practice in dealing with large congenital or acquired skin malformations. Large

nevi, hemangiomas, lymphangiomas, fibroids, hairy moles and different types of pigmented skin areas can often be eradicated by repeated excisions, leaving no trace of surgical intervention other than a linear scar. If shifting of the surrounding skin cannot be accomplished, free or pedicled skin grafts may be used. Although radiation (x-ray and radium) in the treatment of these skin conditions is often followed by improvement, the misuse of this therapy is too often uncalled for. The treatment of extensive skin blemishes, by radiation exclusively, often involves a great economic waste and thereby subjects the patient to the most trying mental distress. The writer has yet to see a case of a nevus completely eradicated by this method. Prolonged irradiation is always followed by a scarred skin which stands out conspicuously from the surrounding area.

SUMMARY

Because of its extensive development plastic surgery has become an indispensable surgical unit in the general hospital.

The relationship of this surgery to other specialties must be based on its definite indications.

The manifold problems involved in the prevention and treatment of deformities caused by automobile and industrial accidents as well as by burns can be properly

handled only by those thoroughly familiar with plastic surgery procedures.

The successful reconstruction of highly hypertrophic and atrophic prolapsed breasts is at present assured by the method of subcutaneous transposition of the gland with mastopexy.

Plastic repair in otorhinolaryngology as a rule should not be attempted by nose and throat specialists, and the association of plastic surgery with the laryngological service in a general hospital should be avoided. The end-results in rhinoplasties are uniformly successful if this surgery is performed aseptically and with proper skill.

Intricacies of plastic repair in the paraorbital region are due to the different types of skin grafts required in a relatively limited area, and the great functional importance of the eyelids. Cicatricial contractions around the eyelids are the most common indications for this surgery.

Cleft lip and cleft palate, repaired at an early age, should in the majority of cases be followed by a satisfactory end-result.

A variety of skin conditions such as nevi, hemangiomas, lymphangiomas, large hairy moles, extensive pigmentation and scars can be successfully eradicated by plastic procedures, followed, if necessary, by the application of physical agents such as x-ray and radium. A great economic waste will thus be avoided.

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INJECTION TREATMENT OF HEMORRHOIDS*

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OF the therapeutic measures available for the treatment of uncomplicated internal hemorrhoids, the injection method is still not clearly understood by physicians in general, nor are its merits fully appreciated. Doubtless this is due to the prejudice engendered by its unfortunate early history.

In 1870, Mitchell of Clinton, Illinois, first used carbolic acid as the injecting agent. Irregular practitioners, mostly itinerant, exploited the method, treating all types of hemorrhoids, often under unfavorable circumstances and with too strong solutions. Ulcerations, sloughing, and other complications occasionally ensued, but less frequently than we might expect in view of the circumstances. As a consequence, reputable physicians ignored the treatment without seriously investigating it. However, during the past twenty-five years, many surgeons in various parts of the world, have investigated this form of treatment, defined the classes of cases in which it is suitable and placed it on a scientific basis. As a result, treatment by injection has grown in popularity, especially during recent years. Striking evidence of this is the frequent request by physicians for this form of treatment when they themselves are suffering from hemorrhoidal disease.

Selection of Cases. The success of the treatment depends on the selection of suitable cases. External piles should never be injected, although I have seen cases so treated by inexperienced physicians with disastrous results. Only uncomplicated cases of internal hemorrhoids are suitable for treatment by injection, and this comprises about 65 per cent of all cases of internal hemorrhoids.

Complications which contraindicate treatment by injection are certain patho-

logic changes in the hemorrhoids themselves. Markedly ulcerated, inflamed, strangulated, thrombosed, or gangrenous hemorrhoids, and prolapsing piles which have undergone advanced fibrosis, should be operated upon and not injected. Complicating pathology which bars injection includes hypertrophy and spasm of the anal sphincters, inflamed skin tags, fissure, fistula, and rectal polypi. However, when these conditions have been corrected by surgery, the hemorrhoids, unless removed at the same time, may be injected.

A word of caution may be expressed here when it is realized that 15 per cent or more of patients with carcinoma of the rectum have had hemorrhoidectomy performed within one year of the time they present a growth palpable by the finger.

Hemorrhoids secondary to mechanical conditions such as displacements of the uterus, cirrhosis of the liver and a "back pressure" of uncompensated heart disease may recur, whether operated upon or injected. In these major states, treatment should be directed to the causal condition. Injection of the hemorrhoids is contraindicated and unjustified unless the piles cause great discomfort, and bleeding is more than is salutary in relieving high blood pressure or venous congestion.

Prolapse of the hemorrhoids does not oppose injection unless the sphincters are markedly relaxed or weakened by inexpert division of the muscles, as in an operation for fistula.

Treatment by injection, then, is indicated in all uncomplicated cases of internal hemorrhoids, including those which prolapse, provided that the prolapse is not due to loss of sphincter control. Suitable cases include particularly the anemia dependent upon hemorrhoidal bleeding in which the results are instant in checking

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hemorrhage. In the early cases of discomfort and slight bleeding, patients readily accept treatment by injection but defer operation until severe symptoms develop. Injections are safe in pregnancy, cardiac and renal disease, in diabetes and in the aged. Persons not able to spare the time from business or other engagements for operation will frequently accept treatment by injection.

Chemical Agents. Carbolic acid in various combinations is the essential popular agent. I commonly use a modified Shuford's solution:

Phenol	5i
Acid salicylic	3ss
Sodium boratis	5i
Glycerin (sterile) q.s. ad	5i

This makes a 12½ per cent solution of phenol. A 10 per cent solution of phenol in equal parts of glycerin and water is equally good. Another combination is a 5 per cent solution of phenol in vegetable oil—sweet almond or cotton seed. The tendency has been from stronger to weaker solutions. Those under 10 per cent are not efficient, while strengths above 20 per cent are prone to produce tissue necrosis rather than the desired aseptic inflammatory reaction. An inherent virtue of phenol is that it is slightly anesthetic and a strong antiseptic.

The only other drug used extensively for injection is quinine and urea hydrochloride in a 5 per cent aqueous solution. Terrell of Richmond, Virginia, first employed this drug in 1913 and, in 1924, reported that he had used it in 3000 cases, stating that "the results have been uniformly good." He had no deaths and only a few minor complications. Before using this drug, one should ascertain if the patient has an idiosyncrasy to quinine.

Dukes studied microscopically the changes provoked in the tissues by injection of phenol solution in 10 patients. After injection in the usual way, the injected hemorrhoid and a control, not injected, were removed at intervals of from one to twenty-one days. He concludes:

Carbolic acid, being a powerful irritant to the tissues, initiates an aseptic inflammation, characterized by a dilatation of the vessels, emigration of leucocytes, and transudation of lymph. By these means the alien liquid is diluted and removed, therefore the inflammation quickly subsides. All the changes observed microscopically represent the effort of the tissues to repair an injury. The curative effect of injections does not depend upon any specific action of the chemical substances. The early inflammatory changes which occur in the first three days do not play any important part in the cure of hemorrhoids; it is the secondary changes, in particular the intravascular clotting and subsequent fibrosis, to which any beneficial effect must be ascribed.

Technique. No anesthesia is used. The patient with rectum empty, is placed in the left lateral position with hips at the edge of the table. Good illumination is essential. Some surgeons use an open end anoscope but I prefer a Brinkerhoff speculum. This is smeared with lubricating jelly, not vaseline, and introduced into the rectum and so adjusted, as its slide is withdrawn to the dentate line, that the pile to be treated prolapses into the slot. For accurate control of the amount of fluid injected, a 1 c.c. all-glass syringe with a goose-neck extension and a short, sharp needle of 25 gauge is satisfactory, or 20 gauge for oil solutions. The mucosa is wiped dry and the point selected for puncture is touched with an antiseptic. The needle is inserted just above the base of the hemorrhoid and advanced to its center. Depending upon the size of the hemorrhoid and degree of prolapse, from 5 to 15 minims of the solution are injected very slowly. After its withdrawal, a pledget of cotton is applied to check any slight oozing of blood. Vaseline is then smeared over the surface of the pile and the speculum removed, care being taken to restore the piles well within the rectum.

Some surgeons inject 2 or more hemorrhoids at one sitting. I usually treat one at a sitting and at intervals of from five to seven days. Four to eight treatments suffice for an average case, but

the injections should be continued until all the hemorrhoids are completely shrunken.

An accurate record is kept of the date, amount and kind of solution, and site of injection. The patient should refrain from severe physical exertion during twenty-four hours after each treatment, but may keep business engagements. He is allowed his usual diet and daily bowel actions are encouraged. He is especially instructed to replace within the rectum any protrusion immediately that it occurs.

When prolapse is a marked feature, the 1 to 5 per cent solution of phenol in oil is effective. From 2 to 5 c.c. of this solution are deposited beneath the loose rectal mucosa at the upper pole of the hemorrhoid. The ensuing fibrosis draws up and attaches the mucosa to the muscularis and frequently at the same time obliterates the pile. If the latter persists, it is later injected directly.

Complications after injection are rare and are usually due to faulty technique, use of too much or too strong solutions, or injecting unsuitable cases.

Hemorrhage, if any, should be controlled by pressure before the speculum is removed.

Slough of mucosa indicates that too much fluid has been used or that it has been deposited too superficially. It is better to inject too little rather than too much fluid.

Infection, which should never occur, may result in a marginal abscess and a fistula.

Abscess of the liver and septicemia have been reported but have not come within my experience.

Pain. Both the introduction of the needle and the injection should be painless. Pain at the time of treatment is evidence that the injection was made so near the dentate line that some of the solution infiltrated beneath the highly sensitive lining of the anal canal. A tran-

sient feeling of weight and fullness in the rectum passes off in a few hours.

By local examination forty-eight hours after treatment, the injected pile is felt as a firm swelling, tapering above into a cord-like induration. If the injected pile has not shrunken completely at the end of two weeks, it is injected again.

There is nothing secret or mysterious in the injection method of treatment, but experience develops confidence and skill in its application. The technique is comparatively simple but must be observed with scrupulous detail. The beginner will avoid needless anxiety and possible complications by first observing the procedure in the hands of a competent operator. Injection of an occasional patient by persons without definite knowledge of the indications and technique invites disaster and casts discredit on the method.

With flawless technique in suitably selected cases, the injection method, more than any other, complies with the criteria of a satisfactory ambulatory treatment, viz.:

No anesthesia.

Little or no pain during or after the treatment.

No detention from business or social duties.

Prompt symptomatic relief and a large percentage of permanent cures, the parts being left in a sound condition and functioning normally.

Economy for the patient in time and hospital charges, and for the hospital in sparing beds for more serious cases.

During the past sixteen years I have employed the injection method of treatment in several hundred cases with very satisfactory results, no deaths or serious complications. Recurrences in from two to five years are estimated to occur in 5 to 15 per cent of cases. However, as the treatment is not onerous, patients with recurrence are so well satisfied that they frequently return for another course of injections.

THE PROBLEM OF THE CARTILAGE IMPLANT*

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THE growing necessity of use for a malleable material for implants in reconstructive surgery has led to special study of cartilage as a medium. Heretofore cartilage has been more or less regarded as an ambergris-like product, shaped with difficulty, infective to the highest degree and liable to absorption. On the contrary it is an easily accessible substance, available in assorted sizes and amounts sufficient to excess for ordinary reconstructive purposes. It, while subject to infection, reacts remarkably well and given ordinary antiseptic aid usually remains in situ with surprisingly small loss of substance.

There have been various schools and individuals, who attracted by the ease of procuring isogenic implant material, have mustered up a regiment of toothbrush handles and associated materials such as paraffin, pyralin and the celluloids in place of autogenous grafts. The controversy has been classified by the observation that infected cartilage may be left in situ with a high percentage of retainment, while brave is the surgeon who will battle infection by leaving an inorganic foreign substance in a pyogenic battlefield.

The choice of cartilage depends upon the amount necessary for reconstruction and whether the implant is to serve purely cosmetic or partial functional purposes. For example a nose with a slight saddle deficiency (Fig. 2A) or one with an exaggerated dish face deformity (Fig. 3A).

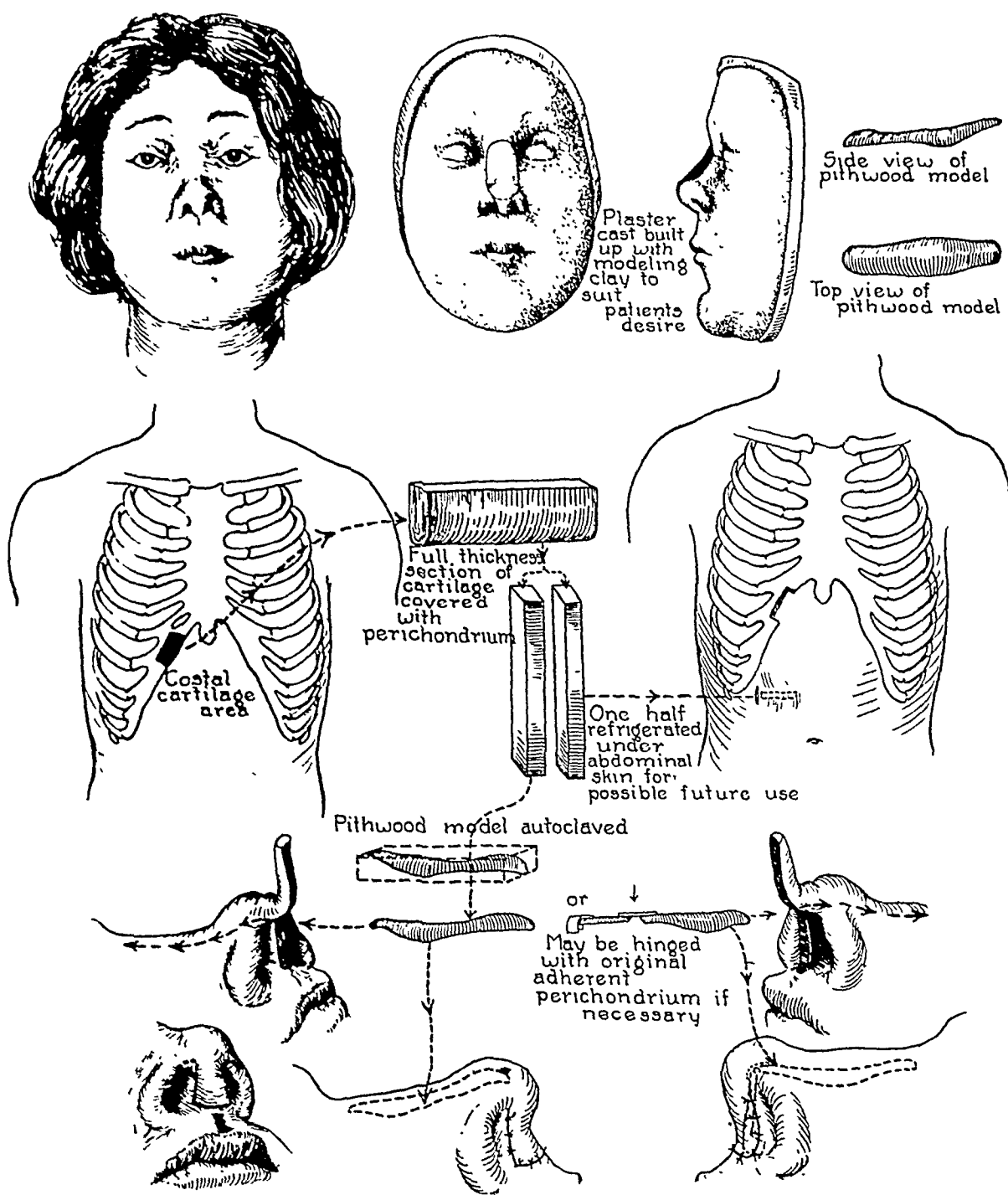
If only a small amount of replacement material is necessary as in a "first degree" saddle nose the lateral nasal cartilages offer an excellent substance from adjacent territory. If a larger amount is necessary as a

primary or secondary implant, ear cartilage will yield a limited amount. When a goodly supply is demanded the costal cartilages of the seventh, eighth and ninth ribs on both sides are available. The right side is usually chosen because of less chance of cardiac concussion and lessened possibility of pericarditis following a possible pleurisy. In infants or children, where there is hesitancy in approaching the chest, the crest of the ilium up to puberty offers an easily accessible supply. There are advocates of septal cartilage which is brittle and almost useless and of the turbinal bones which are noted for their inability to withstand infection and as chronic bacterial hosts.

Ear, lateral nasal, and costal cartilage, aseptically handled will exist implanted without bony contact in contradistinction to bone grafts which demand bony contact. The question of absorption or growth is, I believe, fairly well settled in the minds of the men dealing with implants.¹ Absorption does not occur in the absence of infection or of long continued surrounding hematomas. Whether or not cartilage transplanted before puberty (Fig. 4 A and B) will grow in correspondence with body growth is a mooted question, which I think may be answered by the fact that operative necessity to prevent curling of the implant necessitates the stripping of the perichondrium which furnishes the growth stimulation. The fact is, that cartilage transplanted lives entirely in the surrounding lymph juice, deriving its nourishment as a parasite much the same as a skin graft's early existence.

For a long time the school which advocated bony grafts for plastic reconstructive surgery flourished. When public demand for cosmetic as well as functional results

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METHOD OF UTILIZING COSTAL CARTILAGE FOR RECONSTRUCTION OF NASAL DEFECTS.

RECONSTRUCTIVE PLASTIC SURGERY CLINIC-H.L. UPDEGRAFF M.D. HOLLYWOOD, CAL.

FIG. 1. Costal cartilage implant route. Pithwood is used for model material as it is easily fashioned and stands autoclaving perfectly.

triumphed, the nonabsorption and malleability of cartilage were the deciding factors.² The argument for bone grafts

around the graft, which allows for a slightly smaller graft than called for by a seemingly correctly sized model.



FIG. 2A

FIG. 2B

FIG. 2A. Slight saddle deficiency which caused bad "camera angle" in moving picture photography.

FIG. 2B. Corrected by costal cartilage implant.

with the necessity of bony contact—the difficulty of modeling—the higher level of aseptic technique demanded, and the lower resistance to infection, were countered with the argument that cartilage eventually became bony. If this be true and portions of the cartilage implant do become ossified, once function is fulfilled, an added value is created.

In facial reconstruction involving a return of nasal, malar, frontal, zygomatic, or mandibular appearance the use of the plaster cast as a model is of primary importance (Fig. 1). Once the cast is made, modeling clay or plasticine is used to rebuild the missing portions. This in turn is replaced by a model carved from pithwood which handles a great deal like cartilage and autoclaves without loss of shape. It may be suitably marked as to orientation. One should remember that there is a tendency to build up with connective tissue



FIG. 3A

FIG. 3B

FIG. 3A. Dish face deformity interfering with breathing.

FIG. 3B. Function restored by hinged costal cartilage implant.

The obtaining of the costal cartilage has been described in practically every surgery of any latitude. Yet to the beginner it presents a real difficulty because of the ordinary variations of the costal arch. A straight incision some 10 to 12 cm. in length starting at the right of the xiphoid process will ordinarily reveal a fruitful field. A small rule measuring the model and applied to the costal cartilage in situ will aid in gaining the required amount. The error is usually in obtaining too little. It is to be remembered that a double amount is required to offset not only possible trouble in modeling but to supply an extra amount for refrigeration. This is placed under adjacent skin so that if there is need, countenanced by trauma or infection in the implanted site, of more cartilage, then there is an added supply at hand without the painful possibility of reentering an already plundered costal cartilage field. Most postoperative hematomas occurring in the costal area following cartilage removal come from the injured branch of

the internal mammary artery which may be avoided by staying close to the posterior side of the costal cartilage. Ordinarily the

shape the model unmolested while the assistant closes the chest wound. Ordinarily the obtaining of the graft is the first



FIG. 4A

FIG. 4B

FIG. 4A. Nose broadened and breathing interfered with by septal abscess allowing proximal upper nasal respiratory passage to collapse.

FIG. 4B. Condition improved by costal cartilage implant.

wound is closed without drainage but a troublesome spurter or an inability to fill in the dead space occasioned by removal of the cartilage indicates forty-eight hour drainage.

The modeling of the costal cartilage for nasal reconstruction is divided into straight and hinged pieces. If it is desired to provide a columellar splint as well as a bridge reconstruction, care must be taken in stripping the perichondrium to leave the perichondrium attached at the hinge and at the tip, to attach to the inferior maxillary spine. The perichondrial hinge should be made lax enough so that contraction will not have a tendency to straighten out the pieces, causing an irregularity of the nasal profile.

Once the cartilage chunk is lifted from the chest wound it is transferred to a separate sterile table, preferably off in one corner of the room where the operator can



FIG. 5A

FIG. 5B

FIG. 5A. First degree saddle nose with wide bridge.
FIG. 5B. Reconstructed by implant of patient's ear cartilage.

operative step as this allows a clean field. Much has been said about the possibility of losing the graft on account of its slipperiness while being worked with. I have found that a large piece of pithwood makes an excellent working base. I can see no objection to holding the cartilage with the gloved hand or a piece of gauze instead of the customary instrument technique which while it theoretically lessens aseptic pitfalls, renders correct modeling difficult.

The most perplexing problem with the costal cartilage grafts aside from prevention of infection is the avoidance of curling after implantation. The desire to take advantage of the natural curve oftentimes found in the extracted piece may lead to difficulties in over-correction once the natural spring of the cartilage is released for several hours from its surrounding anatomical restraints. Most operators have realized the necessity of completely stripping the perichondrium to avoid bending when the perichondrium contracted, unless there was a desire to take advantage of this fact. I have found that once the peri-

chondrium is removed the graft is best modeled by *scraping* with a Bard Parker No. 15 blade, the pithwood model, a

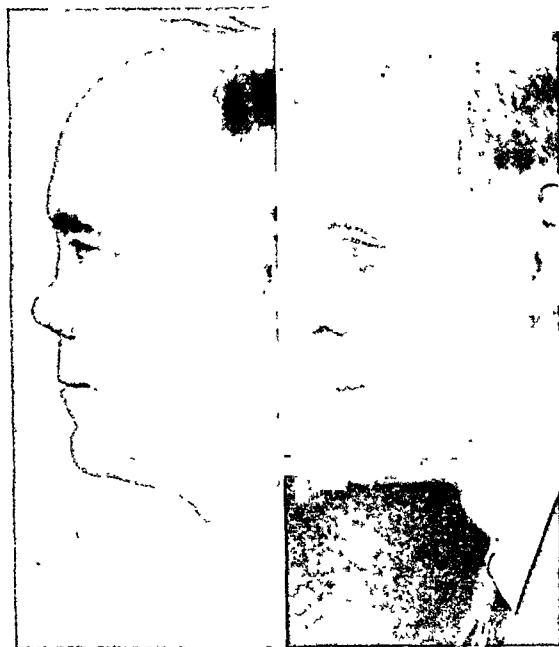


FIG. 6A

FIG. 6B

FIG. 6A. Traumatic saddle nose. Nasal arch has been impacted markedly.

FIG. 6B. Costal cartilage implant through columellar incision.

rule and measuring calipers at hand to aid.

Most textbooks speak of hollowing the under surface of the graft implant in order to prevent side slipping. I believe this is one of the most potent reasons for the graft's curling, aside from incomplete removal of the perichondrium and as the average surface which the implant is placed on is flat, simple roughening of the under surface is sufficient.

The use of ear cartilage where a moderately long flat piece of slight thickness is desired is to be considered (Fig. 5A and B). There is a lack of stability due to absorption of possible eventual ossification, which with the limitation of material renders it a source of definite qualifications. However, to the public, it is a well known plastic crutch, the charlatan relying on the fact that there is quick connective tissue response to bolster up the implant, following recession of the swelling. This added

to the cartilage accessibility is used as an "office operation" selling talk with the erroneous statement that ear cartilage persists while costal cartilage is absorbed.³

The great majority of operators prefer costal cartilage for the reasons enumerated. There is a possibility in cases before the age of puberty, where congenital or large traumatic defects are present, that an additional supply may be desirable. The crest of the ilium offers an easily accessible supply at this age. I have found occasion in several instances where a more permanent suture than chromic catgut was desired to keep large pieces of cartilage in approximation, that fascia lata strips were of value. Refrigeration of all excess cartilage, that could possibly be of use if further implants are necessary, is accomplished by hoarding the excess under the skin of the abdomen or breast. Thought should be given of possible interference later by brassiere or waistline constriction. The changing feminine styles render this somewhat of a guessing game.

The placing of the modeled implant, whether it be nasal, mandibular, zygomatic or supraorbital, renders a problem of making the incision so as to render the scar as inconspicuous as possible. It seems infantile to mention "Langer's lines" to any one who has read this far, but the helpful fact remains, that attention to the lines of subcutaneous tension and skin muscle attachment is important. Many an otherwise successful bit of plastic surgery has been discredited because the surgeon had planned his incisions unwisely.

In preparing the subcutaneous pocket for the implant, it is well not to undermine too much or yet too little. The amount is determined by the elasticity of the skin and the necessity of the relief of skin distortion from old scars or scar tissue. Ordinarily in the reconstruction of a facial deformity, it may be well to consider whether or not additional plastic procedures may be necessary, before the placing of the implant. Total rhinoplasty⁴ for instance, has been improved by the attachment of the fore-

head flap to the nasal base and a sufficient-time interval allowed to elapse, before an implant if then necessary, is placed. This is

cartilage implants that the line of incision be not directly over the implant, to guard against postoperative swelling or moving



FIG. 7A. Old osteomyelitis of jaw. Patient has history of five previous operative attempts at reconstruction before having a cartilage implant.

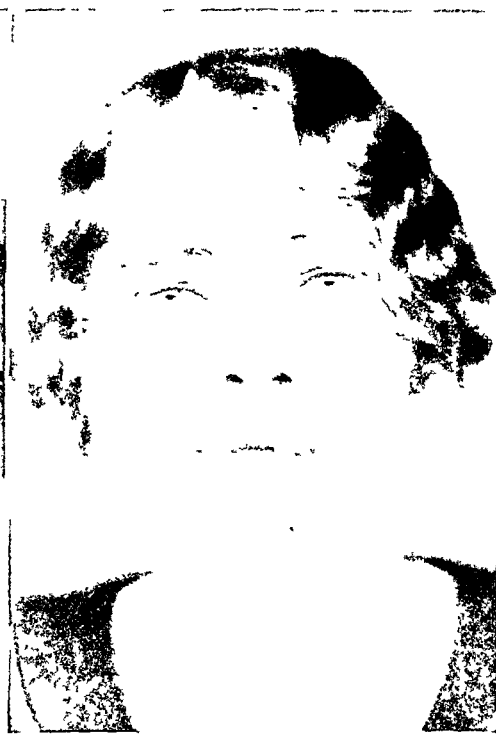


FIG. 7B. Costal cartilage implant 6 cm. long has been placed through small incision underneath mandible.

true also, in those conditions where a covering of thin scar tissue would but poorly tolerate the introduction beneath of cartilage or bone. In these cases preliminary skin grafting, whether free or pedicle in nature is of value. The costal cartilage might be removed and refrigerated at the same time as the preliminary operation if desirous. Experience has proved in removal of portions of the mandible to be replaced later by an implant, that it is advisable to implant a temporary model of vegetable ivory, so that the pocket may be ready for the cartilage implant, without unnecessary dissection.

The columellar lift⁵ offers a satisfactory incision and exposure for saddle nose reconstruction by cartilage implants (Fig. 6 A and B), regardless of whether they are of the adjacent lateral nasal, aural or costal cartilage origin. Mandibular defects are best attacked by an incision underneath the chin (Fig. - A and B). It is well in all

causing the incision to open and expose the implant. An interesting combination of cartilage implant and skin graft subsequently, to move the implant to its ultimate goal is in the reconstruction of a total ear first suggested by Gillies⁶ and more recently used by Pierce.⁷

The external dressing of the area reconstructed by the insertion of the implant, consists somewhat of judicious neglect and efforts at immobilization. Twelve-hour drainage of the implant bed is more of an aid than a hindrance to asepsis, in the prevention of a hematoma surrounding the implant.

I have given up any attempt to "through and through" suture, to hold the implant in place, except in children. Stent modeling compound, adhesive rolls and special metal splints are all applicable in their needed place. The Simpson intranasal splint used bilaterally at times serves admirably. Pressure splinting should be

maintained ordinarily from two to five days, then simple adhesive dressing. The regression of tissue swelling around the implant will be followed by connective tissue formation insuring adhesion and the filling in of subcutaneous defects. When this time arrives, following the period of doubt in the surgeon's mind as to whether or not infection or viability is present, one is apt to be thankful for Nature's tendency in this behalf.

Should infection set in, incision and drainage at the proper location should be instituted at once. A large portion of the implant will ordinarily persist if left in situ even in the presence of a moderately acute infection. I have found a 1 to 1000 acriflavine in water solution to be of great help

as an antiseptic. The problem of cartilage implants is one of the most fascinating in surgery and there are few more grateful patients than those benefited by successful carefully planned cartilage implants.

SUMMARY

1. Autogenic cartilage is much better than isogenic implants.
2. For facial reconstruction cartilage offers a superior medium to bone.
3. Reconstruction aided by casts, modeling clay and pithwood models offers an accurate basis for restoration.
4. Sufficient cartilage may be obtained from the nose, ears, ribs and ilium to supply the average demand.

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The American Journal of Surgery

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The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is not "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIALS

APPENDICITIS

MEDICAL literature, like the style of one's dress, changes with the times and to a certain extent in a faddist fashion. In the early days of John B. Murphy the mortality from appendicitis was exceedingly high (20 per cent or more), but because of his and others' dingdong methods of bringing before the profession and laity the importance of an early diagnosis and operation, it was cut in two. At that time no State or National Convention was without its article or articles on "Acute Appendicitis," "Chronic Appendicitis," "Appendicitis with Peritonitis," etc. But a lot of water has run under the bridge since 1909 when Murphy wrote his masterful article in "Keen's Surgery" on that subject and hundreds of medical schools have brought forth thousands of

doctors in the last twenty-two years, some of whom knew not Murphy or his teachings. Probably because the bright light of the attention has been focussed on other surgical conditions mortality in appendicitis has increased during the last ten years.

When we consider that practically all acute abdominal emergencies occur on the right side and that the symptomatic if not the anatomical area for these can be covered with the outstretched hand, it is excusable at times if appendicitis is mistaken for pelvic pathology, acute perforation of a duodenal ulcer, gall bladder or pancreatic disease, kidney colic, to mention only the most likely. If it were true that all cases of acute appendicitis went on to rupture and abscess formation, there would probably be fewer deaths from this

disease because then both the profession and laity would demand operation as soon as the diagnosis was made and not wait to see if it could be "frozen out" or "scattered." The trouble is that following an acute onset, we do not know which way the "cat is going to jump," whether the infection will subside or go on to perforation.

Of all the aids in making a correct diagnosis the most important is an intelligently taken history. A former president of the American Medical Association said a few years ago that a physician should be able to make a correct diagnosis in 70 per cent of his cases in his bathing suit, i.e., sans stethoscope, sans thermometer, sans pipets, sans everything. Granting that this is a little drastic it is nevertheless true that with a good history and physical examination a large proportion of cases can be diagnosed without laboratory aids. This is not intended to minimize the importance of the latter but it is pathetic to see a physician waiting from one leucocyte count to another to decide whether his patient should be operated on or not. Ochsner once said that he always got a leucocyte count but never looked at it until after the operation.

Acute abdominal conditions are more difficult to diagnose in children than adults. Colicky pains are not infrequent and nine out of ten patients are relieved by a cathartic or enema or by nothing at all. It's the tenth case, that begins like the other nine that lands the child in the hospital with a ruptured appendix. How to tell the difference, that is the point! Probably the only safe way is to treat all abdominal pains as if they were surgical conditions until a more convincing diagnosis is reached. This is very simple and consists mostly of don'ts. (1) Don't give a cathartic because it causes increased peristalsis and makes the bowel content more fluid; (2) don't give solids or liquids by mouth for the same reason; (3) don't give morphine to control the pain as it obscures symptoms by lowering an effective smoke screen through which the

keenest diagnostic eyes cannot see. Of course, the working diagnosis having been made, and a definite procedure decided upon, it may be not only correct but humane to administer morphine; (4) don't put off making a working diagnosis until "tomorrow" in hopes that the symptoms may subside and don't let emotional desires to please the patient or the family stand secondary to an intelligent understanding of his needs. It has been said that without the diabolical aid of cathartics there would be no ruptured appendices. Be this as it may, one sees very few cases of abscess or peritonitis that have not had a purgative of some kind.

The question of incision in appendicitis is an important one and has long been a cause of differences among surgeons, some preferring the right rectus and others the McBurney. In a clean case, the choice is fairly optional but where abscess formation is suspected the latter offers many advantages. (1) One does not have to work through a clean field to get to a dirty one thereby spreading the infection. (2) The drain or drains are placed between the fixed cecum and the parietal peritoneum, minimizing the danger of postoperative adhesions and obstruction. (3) There is much less danger of ventral hernia. (4) The mortality and morbidity are considerably reduced.

To recapitulate: the mortality from appendicitis will be reduced to a minimum when (1) the enema is substituted for the cathartic and morphine is withheld until a diagnosis is made, (2) when the course of the disease is reckoned in hours instead of days, (3) when the clinical picture with or in spite of laboratory tests, has the final say, (4) and when operation is resorted to as the best, safest and the most rational treatment. There are no rules that will cover all cases and the best surgical judgment that one can muster, either of his own or from his colleagues, will not always prove as good in retrospect as one could wish.

W. B. MARBURY.

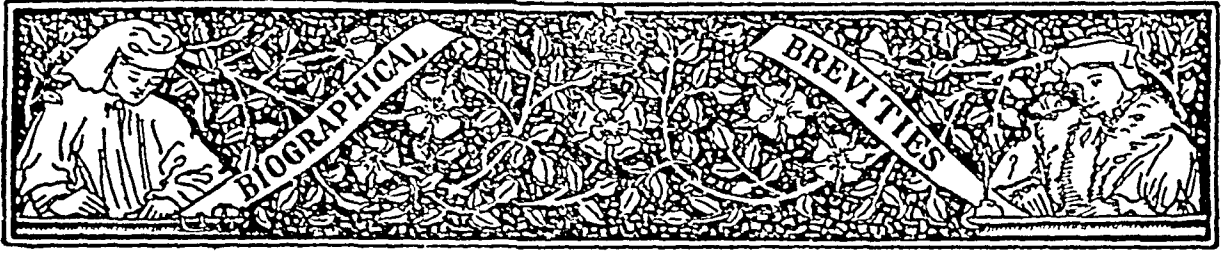


NIELS STENSEN

[1638-1727]

BIOGRAPHICAL BRIEVITIES
"Stensen's Duct"

The American Journal of Surgery
N. S. Vol. xiv, November, 1931



"STENSEN'S DUCT"

NIELS STENSEN, or Steno, was born in 1638. He resided in Copenhagen.

He was a physician-priest. His was a busy life; his vocations were many. A romantic chapter in history deals with his conversion to Catholicism by a sister of that Church. He devoted the better part of his life to religious work. Shortly after his conversion from the Lutheran faith he became Bishop of Tritiopolis (1667).

The other side of the man revealed the scientist. He was a great anatomist, geologist, and physiologist.

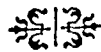
Stensen is known as one of the founders of geology. The geologists of all countries erected, in 1883, a bust over his tomb in the Basilica San Lorenzo in Florence. His treatise, "*De solido intra solidum*" (1669) was epoch making and deals with the production of fossils, strata, and other geologic formations.

In anatomy, his name is known to physicians because of his discovery of

the excretory duct of the parotid gland, Stensen's duct (1661). He discovered the duct while dissecting a sheep. ("*Observationes anatomicae*," Leyden, 1662). Stensen, among other works, investigated the glands of the eye and in 1664 ("*De musculis et glandulis observationum specimen*," Copenhagen) he recognized the muscular nature of the heart. In his discourses on the anatomy of the brain he fell into the common errors of his time. Much of his working time was spent in further studies on the physiology of muscles. He was particularly interested in them from the mechanical and mathematical viewpoints.

From the surgeon's viewpoint he is known because of his anatomical discoveries; the physiologist knows him because of his work on muscles; the geologist as the father of geology. Stensen, priest and scientist, died at the age of seventy-four years, in 1727.

T. S. W.





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

BOOKSHELF BROWSING

ALDRED SCOTT WARTHIN

1866-1931*

WALTER M. SIMPSON, M.D.

DAYTON, OHIO

"THE passing of the individual from the active scene will always be to the human mind an event of the deepest interest; much more so than his entrance into the world. The latter is a wholly uncontrolled event, but the manner of one's departure may bear a definite relationship to one's philosophy of life." Thus wrote Aldred Scott Warthin in the foreword of his last book, "The Physician of the Dance of Death." Doctor Warthin died as he wanted to die, at the height of his activities, on May 23, 1931.

His was a full life and a happy one. To his ardent pursuit of the medical sciences, as teacher and investigator, he added the joys of many refreshing avocations. Born in Greensburg, Indiana, in 1866, Doctor Warthin early manifested a love for music; when he was twenty-one years of age he was awarded a Teacher's Diploma by the Cincinnati Conservatory of Music. An accomplished musician, he found mental rest and peace in the pianoforte.

In 1888, Doctor Warthin received the degree of Bachelor of Arts from Indiana University. It is probable that his interest in the biological sciences was kindled by his intimate associations with David Starr

Jordan at Indiana University; it was here that Doctor Warthin received his first experience as a teacher—of botany. He then entered the University of Michigan, where he received the degrees of Master of Arts in 1890, Doctor of Medicine in 1891, and Doctor of Philosophy in 1893.

While a medical student, Doctor Warthin manifested a particular interest in internal medicine. Doctor George Dock, then Professor of Medicine, was quick to recognize the possibilities of this enthusiastic young student and offered him an assistantship in internal medicine. In 1892, he was made a Demonstrator in the same department; during this year he published a "Scheme for the Systematic Study of Medical Cases." Shortly after this he published a paper entitled "Accentuation of the Pulmonary Second Sound; An Important Sign in the Diagnosis of Pericarditis"; this diagnostic sign has since been referred to as "Warthin's sign."

With the realization that the natural approach to internal medicine was through pathology, Doctor Warthin undertook intensive postgraduate study in pathology in Vienna and Freiburg. In the fall of 1895,

* Submitted for publication Sept. 22, 1931.



Alfred Scott Warthun

he was appointed Demonstrator in Pathology at the University of Michigan. A succession of promotions in rank led to his appointment, in 1903, as Professor of Pathology and Director of the Pathological Laboratories.

Doctor Warthin's thorough training in internal medicine yielded a strong influence on his teaching of pathology. Only a month before he died he stated, "Pathology is not to my mind a separate subject to be taught academically, but one underlying and intimately connected with all the clinical subjects of the curriculum; the correlation of pathology with the living clinical picture represents to my mind the highest function of medical teaching, and were I starting my career again today, I should follow the same ideals and practice initiated in 1895." The institution of regular clinical-pathologic conferences was an early application of this principle.

During the first years of his work in pathology, Doctor Warthin alone gave all of the lecture and laboratory courses, performed all of the autopsies, and blocked, cut, stained and interpreted all of the tissue sections. During his first year as pathologist he prepared some 30,000 teaching sections and spent the hours from one to five each afternoon during the entire year demonstrating these sections to students.

It was during these early days of struggle that William Osler visited the crude quarters in which the laboratory was housed. Osler's interest was stirred by Doctor Warthin's successful efforts in building up a pathological museum from the scant material available. Osler praised him with these words, which he never forgot: "A little field well-tilled! How much more may come from it than from a large one with its surface only scratched!"

A bibliography of Doctor Warthin's contributions to medical literature runs into several hundreds of titles. Perhaps his most important early pathologic researches were those which dealt with the diseases of the blood-forming organs. The completeness

of these studies inaugurated the present-day conception of the nature and function of what was later termed the reticulo-endothelial apparatus. These investigations led him to an early appreciation of the genetic unity and neoplastic nature of chloroma, the leucemias, lymphoblastoma, Hodgkin's disease, myeloma and mycosis fungoides. Interest in the lymphatic system resulting from these studies stimulated his investigations of the thymico-lymphatic constitution, and led to his early recognition of the etiologic significance of constitutional pathologic types in hyperthyroidism (Graves' constitution) and neoplasia.

In 1912, Doctor Warthin reported the occurrence of the fish tapeworm (*Dibothriocephalus latus*) in Michigan. He demonstrated that the larval stage of the worm existed in the muscle of fish in the Great Lakes area, to which region it had been transplanted by Finlanders who had settled in that part of the country. Out of this original observation has grown the recognition of the importance of this parasitic infestation in North America.

Despite the catholicity of his medical researches, it is probable that posterity will first associate his name with his studies on the pathology of syphilis. Curiously enough, his first published studies of the pathology of syphilis were an outgrowth of his diligently prosecuted investigations of the diseases of the blood-forming organs. The title of his first paper dealing with syphilis was: "Congenital Syphilis Simulating Leukaemia and Splenic Anaemia (Banti's Disease)." Then followed a series of some thirty published contributions dealing essentially with the unity of the pathology of syphilis in its various stages. In 1918, Doctor Warthin delivered the Harvey Lecture on "The New Pathology of Syphilis." His newer conception of the disease, particularly as related to latent syphilis of the aorta, heart, testes, pancreas and adrenals, was not greeted with kindness by therapists. Doctor Warthin was prepared to meet every possible objection to his conclusions

by the actual demonstration of the spirochete of syphilis in the pathologic lesions. In order to demonstrate the presence of the organism in the active foci of the disease, a new staining process was devised.

The advent of the World War brought an opportunity to serve his country. Intensive studies were undertaken in the pathology of mustard gas poisoning; the results of these researches were published in book form in 1919. Problems related to venereal infection among soldiers and the relationship between fatty embolism and shock were undertaken at the same time.

Doctor Warthin was more than a teacher and investigator. In literary achievement his name must rank at the forefront of medical writers. His strictly scientific papers were written with unusual clarity and artistry. His first historical essay, "An American Medical Student" (1903), deserves a place with the medical classics. Perhaps his most artistic literary contribution was the presentation of his biologic philosophy of life in the book, "The Creed of a Biologist," published in 1930. Two other books, "Old Age" and "The Physician of the Dance of Death," written during the last three years of his life, will survive as medical literary classics.

For the last six years of his life, Doctor Warthin was Editor of the *Annals of Internal Medicine*, during which time his judicious selection of material for publication, his thoughtful editorials, and painstaking abstracts and reviews, caused this journal to be recognized rapidly as one of the leading American medical publications.

Doctor Warthin gave freely of his time and energy to the many scientific societies of which he was a member. Many of these societies honored him by electing him to the presidency. In 1923, he lent his influence to the advancement of the American College of Physicians, of which he was a Master and the First Vice-President.

A rare tribute came to Doctor Warthin on his sixtieth birthday, when a Festschrift was dedicated to him by his pupils and early colleagues. This anniversary volume occupies a unique place in medical literature in that the papers which comprised the Festschrift were contributed by one or more students in each of the thirty-five classes which he had taught.

No sketch of Doctor Warthin would be adequate without a brief reference to his family life. In 1900, he was married to Katharine Angell. Four children, two sons and two daughters, blessed this happy union. In this stimulating and inspiring home environment, the six members worked and played together, in the beautiful rock-garden, on geological and botanical field trips, in travel and at the fireside. To visit them was a rare treat, and they shared the happy intimacy of their ideal home life with the stream of visitors from all parts of the world.

On the day before his death, Doctor Warthin wrote to the writer of this sketch. He told of his many plans for the future. There was so much more to be accomplished. He had walked that day in his garden and he remarked that "the flowers never looked so beautiful."



BOOK REVIEWS

THE GREAT PHYSICIAN. A LIFE OF SIR WILLIAM OSLER. By Edith Gittings Reid. N. Y., Oxford Univ. Press, 1931.

Edith Gittings Reid, in her short life of Sir William Osler, has achieved the difficult task of weaving the essential facts of a great personality into writing that one puts aside only because of an interruption or when he reads the last line, with regret. It is beautifully written, the tones are subdued but one feels a thrill in the perusal of every page.

We have heard it said many times that every physician would be well rewarded for reading Harvey Cushing's "Life," the biography of Osler that won him the Pulitzer prize. To the right of Cushing's volumes we place "The Great Physician." To us Osler had a tragic life. Surrounded by hosts of friends, having a plethora of honors thrust upon him, called the "greatest physician in history," yet in his heart he loved best of all his son, Revere, the lad who when in his teens joined up in the great war. The pages telling of the anxious waiting, the suspense, and, finally, the telegram saying that his boy was severely wounded, followed by a telephone message from the war-office that he had died, causes a lump to fill the throat. Any one who has lost a boy reading these pages will understand and acknowledge the great spirit and faith in God that was a very part of the fibre of Sir William and his wife.

Surely, this book should be read and reread by all physicians.

Every college of medicine should see to it that their undergraduates carefully read "The Great Physician." Then, Cushing's two volumes should occupy the students' spare half-hours throughout the remainder of the college years. Graduates who have not become acquainted with these two books (and I add the Memorial Volume published after Sir William's death, edited by Dr. Maude Abbott) should purchase them and read them until the pages are well thumb-marked. To read and understand Osler's life is like partaking of a stimulating tonic.

On page 290 I read: "On a slip of paper was found, written during the last days of his life, these words: 'The Harbour almost reached after a splendid voyage with such companions all the way and my boy awaiting me.'"

The greatest physician: the perfect father: and for unnumbered people "their lamp in darkness."

Edith Gittings Reid has written a remarkable book.

RONTGENDIAGNOSTIK DER GALLENBLASE (Roentgen Diagnosis of the Gall Bladder). By Dr. Fritz Eisler and Dr. G. Kopstein. Radiologische Praktika, Vol. xvii, Lex.-80, viii, 153 pages, and 151 illus. Leipzig, Georg Thieme, 1931.

We welcome such an excellent treatise on the radiological aspects of gall-bladder diagnosis, devoting special attention to the development and practice of cholecystography. The work is based on nearly 10,000 gall bladder examinations, mostly by the oral method, of which about 10 per cent have been checked by operation or autopsy. The authors have found cholecystography valuable not only for clinical purposes but also for physiological investigations. Special sections are devoted to persistence of the gall-bladder shadow, pericholecystic adhesions, and pseudovesicular shadows. It is apparent from the long list of references that the authors have studied the literature of the world, yet there are lacking some of the most important South American authors on cholecystography; and even some important work from the United States is referred to only in the Bibliography.

The illustrations are excellent and the arrangement of the work invites the reader's attention.

JAMES T. CASE.

THE SURGICAL CLINICS OF NORTH AMERICA (New York Number—June 1931). Phila., Saunders Company, 1931, Vol. II, No. 3, 239 pp.

This number with articles by New York men is quite on a par with other numbers of this well-known series of clinics.

Of special interest in this number is the report of the Clinical Meeting of New York Fracture Committee of American College of Surgeons consisting of 17 articles on the modern treatment of fractures.

DEMONSTRATIONS OF PHYSICAL SIGNS IN CLINICAL SURGERY. By Hamilton Bailey, F.R.C.S. Ed. 3. N. Y., William Wood, 1931.

Revised and enlarged, with 318 illustrations, some of which are in color, this well indexed, handy volume of 278 pages, deservedly is now in its third edition.

All padding and unnecessary material have been omitted. The illustrations are excellent and follow the text, making the thing as a whole most readable and valuable. The color work is especially well done. We can think of no better work of this type than this one and would urge every medical student add it to his shelf of necessary books.

THE THEORY OF OBSTETRICS. By M. C. DeGaris, M.D. N. Y., William Wood, 1931.

The author says his book is a call to the general practitioner to record, analyze, and think about his cases; so the profession will learn the actual conditions of child-bearing today in different countries and under varied conditions.

The work is concerned mainly with the functional disorders of child-bearing, and especially of labor, as seen in the author's practice. The common custom of most books is reversed; mechanics is taken for granted, and attention is devoted to obstetric function and obstetric medicine.

Part one consists of arguments for a new standard for normal labor. Part two is a detailed analysis of 100 consecutive labors. Part three consists of a tentative effort to apply the new theory to practice.

This work will prove stimulating to the general practitioner and interesting to the obstetrical specialist.

ASTHMA AND HAY FEVER. IN THEORY AND PRACTICE. By Arthur F. Coca, M.D., Matthew Walzer, M.D., August A. Thommen, M.D. Springfield, Ill., Charles C. Thomas, 1931.

This excellent work is divided into three parts. Part 1 deals with Hypersensitiveness, Anaphylaxis, and Allergy. It was written by Arthur F. Coca, Professor of Immunology, Cornell University Medical School. In addition to the topics constituting the section heading, the author deals with Atrophy, Serum Diseases, The Casoni Reaction, The Schwartzman Phenomenon, and The Preparation of Extracts and Solutions for Use in Testing and Treatment in Human Hypersensitiveness.

Matthew Walzer, Instructor in Applied Immunology, Cornell University Medical College, in Part 2, deals with Asthma. The author goes into the history of this affection, discusses the various forms of asthma, the etiology, clinical course and symptomatology and functional pathology, differential diagnosis, and, in great detail treats of the various forms of treatment.

Part 3, by August A. Thommen, Lecturer in Medicine, University and Bellevue Hospital Medical College, is devoted to Hay Fever. The field covered includes the history of hay fever, flowers and pollination, pollen, which plants cause hay fever, hay fever causing trees, the grass family, weeds, sectional hay fever flora, symptomatology and diagnosis, and the treatments.

The book has a good index, is 831 pages long, and well written. In this age every physician in general practice and those who are called upon to treat these diseases would do well to keep this volume at their side and read it carefully.



PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

REGINALD A. CUTTING, M.A., PH.D., M.D., C.M.

TENTH & ELEVENTH INSTALLMENTS

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PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

CHAPTER XVI

CARE OF PATIENTS WITH PROSTATIC HYPERTROPHY

I. THE SURGICAL RISK IN PROSTATECTOMY

Surgery on the prostate gland is a specialized form of surgery in which efficient preoperative care is of the utmost importance. Unless such care is routinely provided and every possible aspect of each case is thoroughly studied the mortality rate is relatively high.

Deaver and Herman¹ have estimated that the performance of prostatectomy at the hands of the occasional or inexperienced operator involves a mortality of between 20 and 30 per cent. With due attention, however, to the blood chemistry picture, to the various methods of estimating kidney function, and to the amelioration of incidental abnormalities the mortality rate can and should be reduced to between 3 and 5 per cent. According to Young² the general mortality in prostatectomy in the hands of the thoroughly competent surgeon has been lowered in the past twenty years from 20 per cent to 2 to 3 per cent, and he has reported a series of his own² of 198 cases with only one death. Davis³ has reported a series of 107 cases with only one death.

The reason for the relatively high mortality rate in prostatectomy is partly to be found (1) in the fact that patients requiring such surgery are almost always advanced in years, usually over sixty, and therefore are frequently handicapped by the general failure of bodily functions characteristic of such an age period, and (2) in the peculiar nature of the abnormalities incidental to the development of the condition which necessitates the operative procedure.

With reference to the characteristics of the age period in which patients requiring prostatectomy fall, aside from the generally diminishing resistance of the patient past middle life, one must be alert to recognize particularly cardiovascular and pulmonary degenerative processes so frequently encountered at this time of life. The incidence of such complications has been estimated as high as 80 per cent for the cardiovascular variety, and 50 per cent for the pulmonary variety. Willius,⁴ who estimates the incidence of cardiovascular disorders more conservatively, states that 42 per cent of patients manifesting prostatic hypertrophy have associated cardiovascular disease, and that this percentage is much higher than the normal incidence of cardiovascular disease in patients of the same age period. This finding seems to indicate that the cardiovascular pathology arises not altogether independently of the prostatic condition, and such a conclusion seems eminently reasonable considering the intimate relation of the prostate gland to the urinary system, and the urinary system to the circulation.

Although acute urinary retention secondary to prostatitis may occasionally constitute an indication for surgical drainage, the operation of prostatectomy is never an emergency procedure. To perform radical surgery on the prostate gland in the absence of a careful preoperative estimation of the patient's reserve capacity coupled with careful preoperative treatment to increase the reserve capacity is but to court failure.

Hunt⁵ classifies the causes of fatalities in prostatic surgery in three groups, (1) those due to preexisting and coexisting organic disease, (2) those due to surgical accidents, and (3) those due to postoperative complications. Of these the first group with its direct and indirect complications accounts for more than 50 per cent of the cases, since the three characteristic types of lesion found, renal, cardiovascular, and pulmonary, are related in such a way that one reinforces the other in a sort of vicious circle. The second group is relatively unimportant (4 per cent) and comprises mainly such factors as hemorrhage,

shock, and the effects of the administration of anesthetics. The third group (40 per cent) comprises many elements, but especially pulmonary complications, embolism, general sepsis, and peritonitis.

II. THE VALUE OF TESTS OF URINARY FUNCTION

Two preoperative measures of kidney function are always available and valuable and should be used simultaneously and supplementarily: (1) the estimation of the ability of the kidney to excrete the foreign dye stuff phenosulphonephthalein, as devised originally by Rountree and Geraghty, and (2) the estimation of the kidney function indirectly by the determination of the amount of urea retention in the blood stream as shown by the methods of blood chemistry. It is important in using these methods that observations be repeated sufficiently often during the period of preoperative treatment so that an accurate check may be at hand at all times on the progress of the patient's condition whether for the better or the worse as the case may be.

In Hunt's⁵ experience less than 6 per cent of patients required cystotomy as a means of preliminary drainage because of intolerance to the use of the permanently indwelling catheter.

Formerly it was considered that the two-stage operation should be used in the vast majority of cases; however, it is now the belief that when properly prepared preoperatively about three-quarters of all patients requiring prostatectomy show no higher mortality rate when subjected to a one-stage operation than they do when the two-stage technique is adopted.

III. GENERAL PROPHYLACTIC TREATMENT OF THE PROSTATECTOMY PATIENT

The operative hazard in the prostatectomy patient varies, other things being equal, directly with the duration and degree of obstruction occasioned by the pathological condition present. Obstruction produces in the bladder wall changes characterized by deformities in shape, the formation of multiple cellules produced by projections of mucosa through

and between muscle bundles in the bladder wall, and ultimately the formation of gross diverticula.

In general the extent of obstruction may be ascertained by measuring the amount of residual urine in the bladder. An amount of 120 c.c. is conveniently taken as marking the transition point below which intermittent catheterization of the bladder for a period of ten or twelve days will suffice to prepare the patient for operation and above which the introduction of an indwelling catheter is preferable.

The performance of cystoscopy is to be avoided in making a preoperative diagnosis if possible since such manipulation can hardly fail to traumatize the urethra and since the essential features of the case can usually be determined without resorting to such a procedure. The size of the prostate itself as well as the presence of bladder calculi or diverticula can usually be determined by rectal examination, so that in the vast majority of cases such a procedure as cystoscopy is unnecessary.

Pyelonephritis not infrequently occurs in connection with the manipulations incident to the preparation of a patient for prostatectomy; usually of urethral origin and originating in the prostatic portion of the urethra, the infection metastasizes by way of the blood stream to the renal parenchyma. In fatal cases multiple small metastatic abscesses are usually demonstrable in the latter. The symptoms of pyelonephrosis consist of a sudden increase in temperature accompanied by a chill. The complication is supposedly self-limited and lasts for from four to seven days during which time the temperature gradually resolves to normal. In the treatment of this condition and proceeding on the assumption that it represents a pyemia, attempts have been made to promote chemical sterilization of the blood stream, or at least bacteriostasis, by the intravenous injection of various drugs. Among those which have enjoyed favor for considerable periods of time are methylene blue, hexamethylenamine, acriflavine, and mercurochrome; the fact that none of these has survived in common use for long periods of time is ample indication of the fact that these drugs

are not uniformly productive of good results. Such treatment has been almost completely abandoned.

The principal danger in connection with preoperative treatment of prostatic obstruction occurs in connection with the relief of urinary obstruction. Many patients defer treatment until retention has become complete and the renal function has been reduced to a point at which the phenolsulphone-phthalein excretion has reached the vanishing-point and blood urea values are as high as 200 to 300 mg. per 100 c.c. of blood plasma. The primary indication is for the relief of obstruction; if this be attempted all at once or too rapidly intravesical tension is so far reduced that edema of the entire urinary tract ensues, and edema within the renal capsule leads to suppression of such inadequate urinary function as the patient previously had. The simplest and probably the most efficient method of gradual reduction of intravesical tension consists in emptying the vesical contents against water pressure. A relatively long tube is attached to a catheter and both are filled with water, the catheter is introduced into the bladder with the free end of the attached rubber tube held high to overcome the intravesical tension; the free end of the tube is allowed to drain into a receptacle, the height of which depends initially upon the intravesical tension, and is gradually lowered as time goes on. Usually it is safe to reduce the pressure completely within a period of from three to four days⁶ (Fig. 63).

Having reduced intravesical tension, the indication is for the promotion of the excretion of toxic retained products; this is accomplished by the promotion of diaphoresis and diuresis, and by purgation. During this process it is most important to determine the water balance, a careful record being kept of the fluid intake and output; a minimal output of 2500 c.c. per day is imperative and usually it is necessary in order to assure this that the intravenous or hypodermic introduction of fluid (preferably dextrose solution) be employed. For purposes of diaphoresis the patient is put in a hot pack at least once a day, and sweating is further promoted by the administration of about 10 grains of aspirin just prior to the administration of the

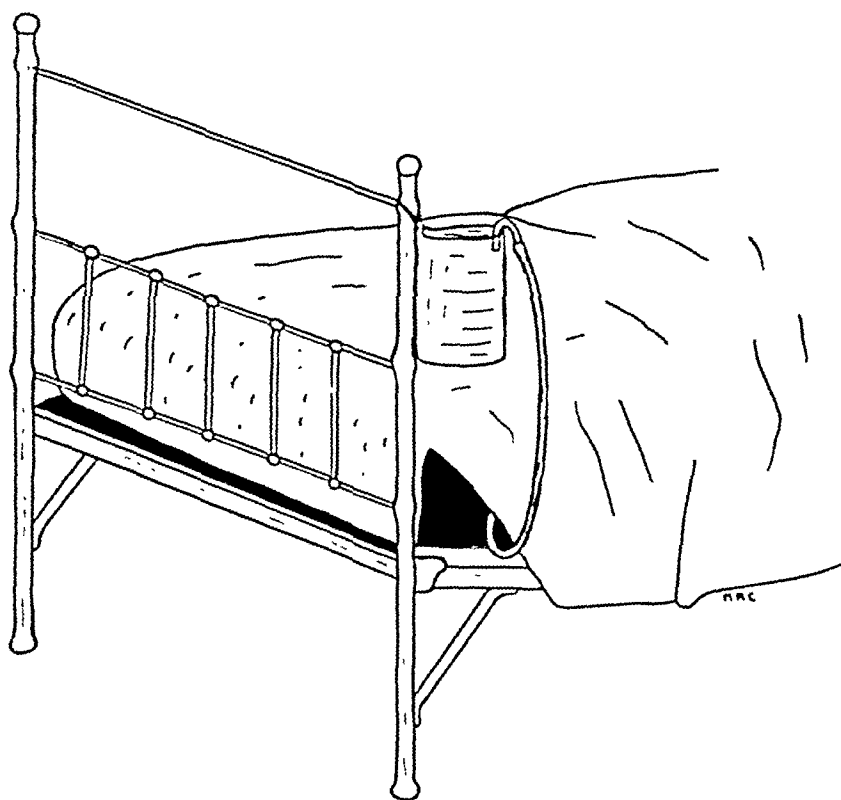


FIG. 63. Simple method of gradually emptying chronically distended urinary bladder. Permanently indwelling catheter has been placed in the bladder of the patient and to it has been fastened the rubber tube which is shown emerging from beneath the bedclothes. This tube terminates in a glass hook which hangs over the edge of any suitable receptacle fastened to the footpost of the bed. At first the receptacle is placed so that the outlet of the tube is about 12 in. above the level of the neck of the urinary bladder of the patient. Once or twice during each twenty-four hours the receptacle is very slightly lowered; this process is continued until the level of the outlet tube has been depressed to the same level as that of the patient's bladder. The rate at which the receptacle can safely be lowered depends upon the reaction which the patient experiences; relief of intravesical tension always produces a depression in the blood pressure, and probably the extent of this depression is about as reliable a guide as can be conveniently followed. Any considerable depression in the blood pressure is, of course, dangerous in a person accustomed to hypertension. In the use of this method the utmost care should be taken to fasten the apparatus in place securely, because if it should by any chance fall to the floor the patient's bladder would, of course, immediately empty itself, and such an occurrence would be a calamity in any case and might even result fatally for the patient in certain cases.

hot pack; pilocarpine is also occasionally of value. In cases of long continued obstruction reduction of urea may be expected to occur at the rate of about 10 mg. per 100 c.c. of blood per day; in more acute cases reduction of the order of 50 to 100 mg. of urea per day is not unusual.

As to the point at which this form of therapy may be discontinued and an operative procedure aimed at the permanent relief of the condition may be performed, it is well if possible to continue treatment until the blood urea content has been reduced to about 40 mg. per 100 c.c. of blood; this is possible only in those cases in which the patient tolerates the treatment well. In emergencies the performance of the first stage of a two-stage prostatectomy may be attempted when reduction to 100 mg. has been obtained; but in cases in which the patient's progress has been slow and loss of weight and strength have been prominent features of the case, it may be well to defer the actual operative procedure for a period of a few weeks, or even a month or two during which the patient is allowed to return home in order to recuperate.

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PROOF

CHAPTER XVII

PREOPERATIVE AND POSTOPERATIVE CARE OF SURGICAL DIABETIC PATIENTS

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CHAPTER XVII

PREOPERATIVE AND POSTOPERATIVE CARE OF SURGICAL DIABETIC PATIENTS

No account of preoperative and postoperative care would be complete without some discussion of so-called "surgical diabetes." Diabetes has now become so highly specialized a disease, however, that an adequate discussion of it would require much more space than is here available for the purpose. Fortunately several excellent monographs are available for the study of those who would become apprised of the minutiae of the therapeutics of diabetes, and to these monographs the reader is referred, especially to the excellent discussions of Joslin¹ and McKittrick and Root.² Such attention as is paid surgical diabetes in the few succeeding pages is designed merely as an outline sketch.

I. THE VALUE OF INSULIN

Patients with diabetes who require surgery are usually advanced in years; the average age for major operations in a series of 304 cases at the Mayo Clinic³ was fifty-four years, and the average age for those requiring minor surgery (363 cases) forty-seven years. Such patients usually suffer from extensive degenerative lesions and are distinctly poor risks. The outlook for the diabetic is, however, infinitely brighter than it was in the pre-insulin days. In the days prior to the introduction of insulin operative procedures of even relatively minor importance on diabetic patients were contemplated with considerable trepidation, since the operative risk in such patients was invariably enormously great.

In the decade prior to the introduction of the use of insulin at the New York Hospital, Weeden⁴ calculated the mortality in diabetics with surgical infections at 40 per cent; for the one-year period following the introduction of insulin in the same hospital, Foster⁵ found a diminution in such cases to 12 per

cent. Most writers reporting series of cases in the pre-insulin period present figures showing a mortality rate in excess of 30 per cent; to cite a few figures, Bruce⁶ 30 per cent, Weeden⁴ 36.8 per cent, Chavannaz⁷ 40.0 per cent, Pilcher⁸ 50 per cent, Bruce⁹ 50 per cent, Strouse¹⁰ 31.3 per cent, Fischer¹¹ 48.8 per cent, Tuffier¹² 40.0 per cent, Meyer¹³ 54.6 per cent, and Fitz¹⁴ 30.0 per cent. Of these Pilcher and Bruce report a mortality rate, as noted, of 50 per cent, and their figures represent the rate in operations for gangrene. Of course, there were some reports in the pre-insulin era showing much lower figures than these, but they represent for the most part operative results in selected cases. Thus Berkman^{15,16} by undertaking a rigid pre-operative preparation of his patients at the Mayo Clinic for periods of from two to three weeks, by attempting no emergency operations, by excluding operations on gangrenous extremities, and by using local anesthesia wherever possible was able to report the very low mortality rate of 7.7 and 5.0 per cent respectively in two series of cases.

Ordinary series of cases reported since the use of insulin has become an established practice show a mortality incidence usually much less than 15 per cent; to quote some figures, Joslin¹ 11.0 per cent, John¹⁷ 8.5 per cent, Mason¹⁸ 15.0 per cent, Weeden⁴ 16.6 per cent, Cohen¹⁹ 14.0 per cent, and Petty²⁰ 9.6 per cent. Bruce,⁶ Judd,²¹ and others have reported figures much lower than these, 2.1 per cent and 3.0 per cent for the last two authors specifically named.

The risk in the diabetic patient occurs not in connection with the actual operative procedure itself, but arises as the result of untoward postoperative complications and sequelae. Probably no better instance of the necessity for cooperation between the internist and the surgeon could be cited than occurs in connection with the diabetic patient, the surgeon being possessed of the specialized information concerning the incidence of these complications and sequelae and the internist possessing a knowledge of how to apply therapy to counteract them. When such cooperation exists in its ideal form the

prognosis is relatively good, and many of the more optimistic authorities have ventured to express the opinion that insulin has made operative procedures on the diabetic patient as safe as similar procedures on otherwise normal individuals of the same age and physical resistance (Christie,²² Gager,²³ Lawrence²⁴).

In the pre-insulin days the complications most feared postoperatively were acidosis and coma; such complications occasionally occur even now, in spite of all that can be done with the use of insulin, but it is probably fair to estimate that at least three-quarters of deaths from these complications can be prevented by the use of proper preoperative and postoperative treatment. Pneumonia, thrombosis, and embolism, postoperative asthenia, and cardiac failure are additional complications, especially to be feared. The highest mortality rate still occurs as it did formerly in connection with the operation of amputation for diabetic gangrene. Olmsted²⁵ has suggested that this high mortality rate can be explained on the basis of intoxication arising from the absorption of autolytic material from the amputation stump, and this even in the absence of either local or general infection. He believes this autolytic intoxication accounts for the asthenia which develops characteristically in such cases.

Diabetic patients who require surgical operations are usually poor surgical risks apart from the factor of diabetes, because they are characteristically not only advanced in years, but their tissues are prematurely old because of early blood vessel changes.

II. THE PREOPERATIVE CARE OF THE DIABETIC PATIENT

In general, preoperative treatment of the diabetic patient is aimed at the accomplishment of four ends: (1) the control of the blood sugar level at as near a normal figure as the exigencies of the case will permit, (2) the abolition of ketosis, (3) the maintenance of the body fluid volume at a sufficiently high level, and (4) the storage of a reserve supply of dextrose in the liver and elsewhere in the form of its polymer, glycogen.

Since it is assumed that the internist will have charge of the stabilization of the carbohydrate metabolism of the patient no extended account of the actual technique of this procedure need be attempted in this connection. Most authorities are in agreement concerning the essential points in this procedure, and these may be mentioned in the interests of completeness. About three days are required for stabilization in the average case:

1. The diet contains 100 gm. of dextrose, about the same quantity (100 gm.) of fat, and 1 gm. of protein for every kilogram of body weight.
2. Sufficient insulin is provided to ensure the complete metabolism of the dextrose and to bring the blood sugar to a normal level, or nearly so.
3. Feeding is continued up to within at least an hour or two of the time set for the operation to begin. The last food is given in the form of fluid only. The administration of a sufficient amount of fluid is highly desirable both from the point of view of prophylaxis against acidosis and from the point of view of ensuring a relatively empty stomach with a view to the prevention of vomiting.
4. Additional dextrose in the form of orange juice and in amounts sufficient to provide about 10 additional gm. of dextrose may be given two or three hours before the operation and in connection with the patient's liquid breakfast, in which case 10 or 20 additional units of insulin should be provided just prior to the operation, and 30 or 40 additional gm. of glucose may be provided intravenously while the patient is on the operating table, as suggested by Duncan and Frost.²⁶

The subject of the anesthetic of choice in connection with operations on the diabetic patient has been pretty well settled. It is generally conceded that chloroform is to be avoided. The administration of ether has its advocates especially at the Mayo Clinic, but Bloor²⁷ has apparently demonstrated that following ether anesthesia there is an increase in the fat content of the blood which is both rapid and progressive, and there can

be little doubt that this predisposes to the development of ketosis. Leake and Hertzman,²⁸ however, apparently have shown that such a condition of lipemia does not occur in connection with ethylene or nitrous oxide administration, at least not to the same extent or with the same rapidity. Consequently, the two latter anesthetic agents are preferred when it is necessary to make use of a general anesthetic. On the other hand, many of the operative procedures required in connection with surgical diabetes may be and should be performed either under local anesthesia or under spinal anesthesia, types of anesthesia which are not, of course, attended by this development.

III. THE POSTOPERATIVE CARE OF THE DIABETIC PATIENT

Immediately following operation on diabetic patients a sample of blood should be secured for blood sugar analysis and CO_2 determination; the analysis of this serves as a guide for the administration of dextrose and insulin. Joslin¹ has made the observation, "Feed the patient up to the last hour possible before an operation; he will most likely fast altogether too much afterward," and this is undoubtedly true in many cases. However, food in the form of oatmeal gruel, ginger ale, and orange juice may frequently be tolerated by mouth at the next regular feeding time or slightly thereafter, especially in case of the less severe operative procedures and those performed under local anesthesia, but the efficacy of the intravenous method of administration of dextrose must never be forgotten in connection with such patients as for one or another reason should not be fed by mouth.

Some authorities advocate the administration of liquid carbohydrate either by mouth or intravenously as frequently as every two hours for the first several postoperative hours, regardless of the apparent general condition of the patient. Others give relatively large amounts of insulin properly buffered with dextrose to guard against the possible development of an unforeseen acidosis, but probably this is unnecessary

except in those cases in which a CO_2 estimation indicates an impending acidosis. It has been stated that in the diabetic patient the subject of infection or acidosis only 1 gm. of glucose is metabolized by the agency of one unit of insulin; at all events the efficacy of insulin is greatly reduced in the presence of infection, and, therefore, one must not expect to be able to calculate insulin dosage on the same basis as in the ordinary case of diabetes.

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CHAPTER XVIII
PREOPERATIVE AND POSTOPERATIVE CARE OF
THE GALL-BLADDER PATIENT

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CHAPTER XVIII

PREOPERATIVE AND POSTOPERATIVE CARE OF THE GALL-BLADDER PATIENT

I. PREOPERATIVE TREATMENT OF THE GALL-BLADDER PATIENT

The preoperative care of gall-bladder patients aims fundamentally not at the amelioration of the local condition as such, but rather at a rectification of certain functional disorders associated indirectly therewith, especially with the rectification of metabolic disorders. Stated in another way, the primary object of the preoperative care of the gall-bladder patient is to make radical surgery safe by rectifying associated abnormalities which make for postoperative mortality and morbidity.

Apart from complications attendant upon operative procedures as such, patients undergoing biliary surgery tend to succumb to one or more of the following complicating disorders, (1) disturbances of acid-base balance, (2) hemorrhage, (3) hepatic insufficiency, (4) uremia, and (5) nephritis.

A. DISTURBANCES OF ACID-BASE BALANCE, ACIDOSIS AND ALKALOSIS: Acidosis occurs with a considerable degree of frequency in the acute case of gall-bladder disease, and this acidosis is not apparently the result of destruction of liver substance, but rather in secondary (1) to a deficient intake of food, particularly carbohydrates, and (2) to vomiting of secretions from the stomach, both of which in turn are secondary to the reflex influence of the diseased gall bladder upon the stomach. In line with the best practice at the present time, most surgeons are unwilling to operate upon the patient having an acute case of gall-bladder disease in the absence of indications that the process is proceeding to actual perforation of the viscus, a complication which fortunately rarely occurs. In those cases, however, in which immediate operation is contemplated in a patient who has been acutely ill for a period of more than twenty-four to thirty-six hours, and best, even

though no such operative procedure is contemplated, a CO_2 determination should be performed as an indication of the acid-base balance. A combining power below 40 volumes per cent is a contraindication to immediate operation, and a definite indication for the institution of measures aimed at restoring the normal alkali reserve capacity. In the average case this can be conveniently and promptly done by the administration of dextrose either by rectum or by intravenous infusion; in the latter case 1000 c.c. of 2.5 per cent solution, and in the former case 200 c.c. of a 10 per cent solution may be given every four hours. Six hours after the first determination of the CO_2 combining power has been made, a second reading should be taken and if the reading has not been raised to 45 volumes per cent or more during this period, the indication is for a repetition of the dextrose administration. Carter¹ advocates the addition of 1 per cent of sodium bicarbonate to the intravenous infusion described here, or 2 per cent to the rectal solution in those cases in which the reading is 30 volumes per cent or less at the start. It should be emphasized, however, that measures aimed at the rectification of acidosis by the administration of sodium bicarbonate should never be employed unless an accurate CO_2 determination has shown such to be safe, since the mere finding of acetone and diacetic acid in the urine, which is usually considered an indication of acidosis, may occur in the presence of alkalosis, and the administration of added alkalis in such a condition might prove disastrous. Patients with diabetes as a complication of a gall-bladder condition usually require dextrose intravenously in not over 2.5 per cent solution. The addition of concentrated sugar solution to the blood of an acidotic patient who also has a relatively high blood sugar is dangerous, since such patients display a viscosity of the blood, and dextrose in concentrated solution, acting as it does as a diuretic, may throw such a patient into coma as a result of further depletion of water from his blood stream.

Alkalosis occurs preoperatively only rarely, such a condition usually developing not as any essential part of the gall-bladder picture, although its development is favored by the vomiting of acid gastric juice. The commonest cause would seem to be the sodium bicarbonate habit which many patients develop in the presence of various gastric disorders, the most usual being peptic ulcer, a condition which may occasionally exist in conjunction with gall-bladder disease.

B. HEMORRHAGE: The tendency of patients with biliary disease to develop uncontrollable hemorrhage has long been recognized. Such tendency to hemorrhage is due to associated jaundice; or, to be strictly accurate, both the tendency to hemorrhage and to jaundice are the result of some fundamental metabolic reaction not well understood of which these are the two outstanding manifestations.

C. JAUNDICE AND DELAYED COAGULATION TIME: C. H. Mayo² has estimated that jaundice is associated with lesions of the biliary apparatus according to the following percentages:

	Per Cent
Obstruction of the common duct by stones.....	50
Obstruction of the common duct due to inflammatory edema (infective or catarrhal).....	20
Malignancy (liver, one-half of the cases; pancreas, gall bladder, and ducts, one-half the cases).....	15
Serious infection of the gall bladder.....	5 to 8

The cause of death in patients dying after operations on the biliary tract is hemorrhage in more than 50 per cent of cases. In this connection many clinical signs have been suggested as contraindications to operative procedures, e.g., the occurrence of subcutaneous hemorrhages, a coagulation time of more than nine minutes, and dehydration in connection with a jaundice of more than two weeks' duration.

The best indication of the danger from hemorrhage to be anticipated in operating upon a patient with jaundice is to be found in the determination of the coagulation time of the

patient's blood. Hemorrhage in cases with jaundice is, of course, dependent upon failure of the blood to clot within a reasonable time interval, and a preliminary determination of the time interval required for the formation of a clot indicates the relative amount of danger to be anticipated from such a source. The reason for the delay in coagulation time in jaundice is not precisely understood; it is assumed tentatively that there is a deficiency of thrombokinase, diminished fibrin content of the blood not being demonstrable.

Van den Bergh³ has estimated the amount of bilirubin in normal blood as one part in 50,000, and when this amount is exceeded the pigment is deposited in the various tissues, including the skin, and is excreted in the urine. King and Stewart⁴ have presented evidence that the toxic element in injected bile is the pigment rather than the bile salts and that when combined with calcium and magnesium the pigment is less toxic than when not so combined. This would seem to indicate that increased coagulation time may be due to decreased calcium content of the blood, the available calcium being depleted to detoxify the circulating bile pigment. Depletion of the supply of available calcium may also account for the bradycardia and for some of the mental and nervous symptoms. Other investigators, however, implicate the bile salts as the toxic substance and explain the bradycardia on the basis of stimulation of the vagus nerve.

Lee and Vincent⁵ have developed a procedure for determining whether calcium therapy will probably be of value in diminishing the coagulation time of blood of jaundiced patients. It depends upon the principle of adding calcium ions to the patient's blood in vitro and determining whether the coagulation time of a specimen of blood so treated is less than that of a specimen not so treated.

To perform the test blood is withdrawn into a syringe by venepuncture, 1 c.c. being set aside to coagulate spontaneously, whereas to another 1 c.c. amount is added 6 drops of a 0.5 per cent solution of a soluble calcium salt. The coagulation time of

each of the two specimens is determined. If the coagulation time of both is found to be the same, the addition of calcium ions has obviously been of no value in the second sample, and the delay in coagulation time is therefore considered not to be due to a deficiency of calcium. If, on the other hand, the specimen to which the calcium was added coagulates more rapidly than the untreated blood, the presumption is that the blood being investigated is primarily deficient in calcium ions, at least in "available" calcium ions, and calcium administrations can be depended upon to affect the situation favorably.

Many methods have been devised for estimating coagulation time, but the more cumbersome techniques have little to recommend them, since the possible margin of error by any method is considerable. Perhaps the Sabrazes method is as simple and satisfactory as any. It consists in allowing a capillary glass tube 0.8 to 1.2 mm. in diameter to fill by capillary attraction, with the blood to be tested noting the time at which the blood was originally drawn, and then at intervals of one-half minute breaking off small portions of the tube and noting the time of the first appearance of a worm-like coagulum between the broken ends of the glass tube. The interval between the withdrawal of the blood and the appearance of the coagulum represents the coagulation time.

Coagulation time is best computed in connection with blood withdrawn from a vein; the normal coagulation time for such blood at ordinary room temperature is from four to six minutes. When attempting to estimate coagulation time on blood obtained by puncture of the skin, it is standard practice to discard the first drop and to use the second or third, because each succeeding drop tends to coagulate more rapidly than the preceding one. The normal coagulation time for blood so obtained at ordinary room temperature may be taken as from three to four minutes. Human blood undergoes diurnal variations in coagulation time, the coagulation rate being usually more prolonged in the forenoon and shortest late in the

afternoon. At a temperature of 20° c. the coagulation time is approximately twice as protracted as at ordinary room temperature.

Petersen and Mills⁶ have suggested an interesting and simple method of maintaining blood at a relatively constant temperature during coagulation time determinations. They use in their method capillary tubes of 0.6 to 0.8 mm. inside diameter and 1.25 in. in length. These tubes are allowed to fill by capillarity up to about $\frac{1}{4}$ in. from the end with blood obtained in the ordinary manner by puncture of the skin. The little tube is immediately placed in one of the creases of the palm of the examiner's hand, and the hand is closed over it. Coagulation is recognized not by breaking the tube, but by failure of the blood column to move within the tube when the latter is inverted. In order to observe the movement of the column of blood, the hand holding the tube is temporarily opened. Inversion of the tube is provided by pronation and supination of the hand. The authors believe that when the temperature of the blood is thus kept virtually at the temperature of the body, one of the most disconcerting variables in any coagulation time determination is eliminated.

In cases of frank jaundice, and in other cases in which the coagulation time is found to be demonstrably increased, prophylactic measures should be instituted to increase blood coagulability. Calcium salts have been widely used for this purpose; they have been administered orally, rectally, and intravenously. Calcium lactate by mouth in doses of 100 gr. per day for three days, has been of value in the hands of some, but Grove and Vines⁷ have adduced experimental evidence to show that the administration of calcium in this manner is valueless. Calcium chloride is used intravenously, 5 c.c. to 10 c.c. of a sterile 10 per cent aqueous solution being injected daily for three days at the end of which time the coagulation time will have been reduced in favorable cases to normal and will remain so for from five to seven days. Prolongation of administration beyond three daily doses is apparently of no value, since the medication

reaches its maximum effect after three injections at twenty-four hour intervals.

In cases in which operation must be delayed for several days after the maximal effect of calcium therapy has been reached, a repetition of the three calcium injections should be performed. Calcium salts when introduced intravenously have an immediate effect in raising the blood calcium content, but this effect is transitory. Blood calcium determinations performed two hours or longer after the injection of calcium characteristically show a concentration at the same level as before injection. Calcium is, however, apparently eliminated from the body very slowly. These two latter considerations seem to indicate that there must be some mechanism for calcium storage.

Calcium therapy in treating delayed coagulation time is relatively untrustworthy and may fail at the most inopportune time. The same may be said of the administration of alien serum and other measures which have been proposed from time to time as of value in facilitating the coagulation of blood. In an emergency, of course, the intramuscular injection of 10 c.c. of diphtheria antitoxin (horse serum) may be tried and occasionally obviates a calamity.

The administration of one or several blood transfusions, however, is the sheet anchor of the jaundiced patient, and succeeds in reducing the coagulation time when calcium therapy and all other measures fail. Accordingly, many authorities are not in favor of even trying the latter at all in the average case; they proceed immediately to transfusion, thus avoiding possible disappointment to themselves and hazard to their patients. In debilitated patients this attitude is to be unqualifiedly recommended, transfusion in these cases being urgently demanded. In other cases transfusion is probably also indicated whenever feasible. The general subject of transfusion has been discussed at length elsewhere.

D. HEPATIC INSUFFICIENCY: Just what is meant or should be meant by this term is not exactly clear at the present time,

because of our imperfect knowledge of the various functions of the liver. However, that the liver suffers definite damage in jaundice can be shown histologically by examining the hepatic tissue of both men and experimental animals following the production of prolonged obstructive jaundice; the liver is small and yellow, and the central portion of the lobules is packed with bile thrombi; the central zone of hepatic cells shows atrophy, and the peripheral cells often show hydropic changes and moderate deposits of fat globules.

That the administration of carbohydrate tends to obviate these changes is strongly suggested by the investigations of various authors, especially Opie and Alford,⁸ who found that after chloroform poisoning, which is, of course, essentially a liver poisoning, dogs fed with fats die most rapidly, those fed with proteins live somewhat longer, whereas those fed on carbohydrates live longest of all. Mann and Magath⁹ were able to keep dogs alive for twenty to thirty-four hours after removal of the liver, by the use of intravenous, subcutaneous, and intraduodenal injections of glucose solutions, whereas animals refused this treatment developed a progressive hypoglycemia and died within six hours. Accordingly, the treatment of this condition consists in the administration of quantities of glucose; percentages as high as 15 per cent may be given by rectal drip, the administration being interrupted for an hour every other hour. The eating of reasonable amounts of candy may also be encouraged.

E. NEPHRITIS: The occurrence of nephritis in association with jaundice is not infrequent; in fact, a large proportion of patients with obstructive jaundice show evidences of a toxic nephritis, albuminuria, casts, and increased blood urea. This has been explained on the basis of a cytotoxic effect of the circulating bile salts on the kidney parenchyma. Haessler, Rous, and Broun¹⁰ have found extensive degenerative changes in the renal tubular epithelium of dogs jaundiced for a considerable period of time, the glomeruli, however, not having

been affected. The treatment is medical, consisting of the usual measures adopted in uremia occurring in other connections.

II. POSTOPERATIVE TREATMENT OF THE GALL-BLADDER PATIENT

A. FEEDING: Water, preferably not too cold, may be allowed in the average gall-bladder case after about six hours following the operation; in case vomiting is persistent fluids should be supplied either rectally or hypodermically. Food is commonly tolerated and should be forced upon the patient at the end of about eighteen hours in case the intestine has not been subjected to surgery; well sweetened tea, gruels, dry toast, and cooked fruits are allowed, as well as the juice of oranges and lemons.

B. POSITION IN BED: Any position may be allowed the patient which is comfortable for him in cases of simple cholecystectomy. In cases in which drainage has been performed the sitting position at an angle of about 35° has the advantage that it promotes drainage and tends to prevent the formation of subphrenic abscess.

C. PAIN: Postoperative pain may be due to any of the factors mentioned previously in connection with abdominal operations in general. A severe sticking pain felt in the epigastrium and radiating to the shoulder, which is similar to the pain of pleurisy and which is not easily relieved by the use of morphine, is frequently due to peritoneal irritation caused by bile spillage or the presence of blood clot in the region of the gall-bladder bed.

D. HEMORRHAGE: The capillary oozing, so frequently encountered and dreaded before the prophylactic treatment of delayed coagulation time became generally used, is not now often seen; the treatment of this complication when it does occur is the same as the prophylactic treatment, calcium chloride, and blood transfusion.

E. DRAINAGE TUBES: Care should be taken that no undue traction be made on drainage tubes during removal lest they be

torn in two thus leaving a piece of the apparatus behind in the abdomen, or by tearing at the anchoring suture bile spillage be precipitated, or cicatricial narrowing of the common duct result in cases of common duct drainage.

F. POSTOPERATIVE ACIDOSIS AND ALKALOSIS: Acidosis characteristically develops if at all on the second or third day. The patient, who may have been resting quietly previously, develops an increase in temperature, pulse, and respiration rate, becomes restless and complains of generalized pain; the tongue and lips present a parched appearance, the epithelium over the latter often appearing scaly; vomiting of gastric contents and bile stained material from the duodenum occurs, and this is usually accompanied by distention. The treatment is as already outlined for acidosis in general; while the acidosis is being relieved, codeine in doses of a grain or two either alone or in combination with bromides is indicated.

Acidosis of a greater degree may occasion more severe symptoms: the eyes appearing sunken, sordes covering the teeth, the lips being parched, the skin moist, cyanotic and lifeless, the pulse racing and of small volume, the respiration being of the sighing variety and restlessness extreme. Such a picture rarely occurs in the absence of peritonitis, and when it does occur it calls for prompt and vigorous treatment, and especially for frequent checking of the efficacy of the same by the chemical laboratory.

Alkalosis is not a very uncommon accompaniment of gall-bladder surgery; it usually is not recognized early because it presents no characteristic premonitory train of symptoms and signs. In the case already developed the eyes and mouth are characteristically closed, the respirations slow and sonorous; the extremities are held in tonic spasm with the knees flexed upon the trunk; the tongue is moist; the pupils are normal. There may be twitching or a coarse tremor of the muscles of the face and the extremities. The skin feels normal. Temperature and pulse rate rise to very high levels twelve to eighteen hours before death.

G. HEPATIC INSUFFICIENCY: The clinical picture of post-operative hepatic insufficiency is fairly well defined. The first three days or a week following operation may have been uneventful and bile may have been draining from the operative wound normally in cases in which drainage tubes have been used. The first change noted is that the drainage becomes somewhat more profuse, but that the color is also paler and the secretion thinner. Within twenty-four or forty-eight hours the exaggerated rate of flow has ceased, but the character of the secretion is thin, pale, and watery. Jaundice does not markedly increase, but emaciation rapidly becomes evident. Rosenthal's phenoltetrachlorophthalein test at this time will show an increasing degree of dye retention. Collapse begins to appear, the temperature becomes subnormal, and the pulse is small; restlessness and irritability ensue, and if the condition is not relieved somnolence gives way to coma, and coma to death.

H. NEPHRITIS: Following operations on the biliary apparatus there is an increase in blood urea, which, however, should not last for more than three or four days; in cases in which the preoperative level has not again been reached by the fifth day the development of uremia should be suspected. Usually the patient will have had a more or less stormy early postoperative period with exaggeration of nausea, vomiting, and distention. The bile draining from the operative wound is apt to be of normal color but scanty in amount. Increasing albuminuria and cylindruria with a cessation of the drainage of bile from the operative wound, and a deepening of the jaundice constitute the usual picture. Phenolsulphonephthalein excretion is found to be at a low level. The treatment is that of uremia otherwise developing.

I. CHOLECYSTODUODENAL THERAPY, THE MCARTHUR INFUSION AND DRIP: The remarkable therapeutic value of dextrose and water in the preoperative and postoperative treatment of gall-bladder patients not only with respect to the development of acidosis and to a lesser extent alkalosis, but also with respect to those complications especially associated with hepatic

disease: postoperative vomiting, toxic nephritis, and hepatic insufficiency, serves as a fitting introduction to the consideration of a special method for administering fluids which, though not available in other types of surgery, is sometimes provided postoperatively in biliary surgery, the method of biliary infusion. The method becomes available whenever the surgical exigencies of the case have required the artificial production of a biliary fistula, or whenever such a fistula develops adventitiously.

Biliary fistulas are produced intentionally by the introduction of drainage tubes into the gall bladder or into the bile ducts; such artificial drainage is commonly adopted in operations for acute cholecystitis, especially when complicated by gangrene of the gall bladder, and in cases of cholelithiasis or biliary duct stones or strictures, especially in cases in which gross infection has already developed or in which there is doubt whether an uninterrupted channel has been re-established for drainage into the duodenum by way of the ampulla of Vater.

The primary object of such external biliary drainage is, of course, the relief of associated cholecystitis, cholangitis, and cholemia through a process of decompression, a direct avenue of escape for toxic secretions being instituted to the external surface of the body. The fistula thus produced, however, may on occasion be utilized for an entirely different purpose, viz., for the introduction of fluid therapeutic agents into the body by way of the biliary ducts and duodenum. Thus, biliary fistulas may occasionally be made to serve a beneficent twofold function, (1) that of a portal of external drainage for toxic secretory products, and (2) that of a portal of ingress for therapeutic agents.

When drainage tubes have been deliberately sewed either into the gall bladder or the biliary ducts, all that is necessary to provide cholecysduodenal infusion is to supply fluid under slight pressure to the free end of the tube; the pressure may be provided by a suitable syringe or by gravity drip, the latter

being usually preferable. When the tube terminates in the gall bladder the injected fluid is conducted thence through the cystic duct to the common bile duct and through the common bile duct to the duodenum by way of the ampulla of Vater; when the tube terminates in the biliary ducts the route is, of course, still more direct to the duodenum through the common duct and the ampulla of Vater. Naturally, fluid flows freely in this retrograde fashion only in case obstructions, in the form of impacted gallstones and strictures, have been overcome at the preceding formal operation, a state of affairs which will ordinarily have been ensured.

When biliary fistulas occur spontaneously, as occasionally happens, or when tubes which were previously introduced have been removed, the biliary apparatus must be catheterized before cholecystoduodenal infusion can be invoked.

McArthur,¹¹ in a brief and unpretentious communication in 1910 first set forth the advantages of the biliary fistula as an avenue for the administration of fluid, and the general method of fluid administration by this channel is therefore properly called the McArthur method, the McArthur infusion or the McArthur drip.

McArthur's attention was first drawn to the feasibility of using the biliary fistula as an additional avenue for fluid administration by his observation that during lavage of the gall bladder, as frequently practiced after cholecystotomy, a certain amount of the fluid used in the irrigation was not recoverable; it had found its way through the bile passages to the duodenum. He then began to experiment with the deliberate administration of fluids by this route and soon found that it was easily possible to administer in the course of twenty-four hours from 500 to 3000 c.c. of warm sterile saline or dextrose solution by adopting the following technique: To the tube draining the gall bladder, or the common bile duct, as the case may be, is attached by means of a suitable intermediate piece of rubber tubing an irrigator container filled with the solution to be administered; the rate of flow is

adjusted so as not to exceed 5 to 6 drops per second, and the height of the irrigator container above the abdomen of the patient is not allowed to exceed 20 in. This method, the so-called "McArthur drip method" usually causes the patient no inconvenience provided the bile ducts are patent and the rate of flow is adjusted as just described; on the other hand, if some obstruction does exist, or if the rate of flow is too rapid, pain like that of mild biliary colic is rapidly engendered, and suitable readjustments of the apparatus must be made at once.

Because of the remarkable absorptive powers of the duodenum simple solutions of dextrose and sodium chloride as well as certain medicaments, like aperients, are very rapidly utilized when this device is used. McArthur found that characteristically the pulse of patients which had previously been easily compressible and rapid, soon became fuller and slower, thirst which previously had been great was overcome, and moisture not previously present was found on the tongue and skin; in short, the method presented an exceedingly efficient and rapid method for the administration of solutions. As secondary effects McArthur believed that he had been able to demonstrate an active diuretic action caused by the absorbed fluids which was of great value in the treatment of associated toxic nephritis and also had seen persistent postoperative biliary vomiting cease promptly after flushing the duodenum with an alkaline salt solution.

Matas¹² in 1911 emphasized the value of the McArthur drip in a more extended presentation and stated that he regarded it as amongst the "life saving measures in the great emergencies which are likely to occur in a particularly dangerous group of biliary infections." Amongst the indications for its use Matas considered (1) chronic obstructive jaundice associated with toxic nephritis, (2) persistent postoperative biliary vomiting, (3) administration of nutrient fluids and unpalatable medicated solutions, especially solutions of calcium which may be valuable in controlling postoperative hemor-

rhage. In this communication Matas particularly emphasized the procedure of deliberate catheterization of the bile passages in those cases in which no tube was already present in the fistula; he recommended, if possible, working a catheter all the way into the duodenum and even allowing several inches of the catheter to protrude into the lumen of the duodenum. He had not only found it possible to pass a fairly large ureteral catheter along the tract of a previous common bile duct drainage actually into the duodenum, but had also been able to work such a catheter through the cystic duct and common duct into the duodenum in cases of simple gall bladder drainage. Matas reviews the theoretical anatomic difficulties offered by such a feat, especially the presence of the Heisterian valves in the cystic duct and the variations in angulation and course of the cystic and common ducts, but inasmuch as he has found the catheterization of these structures actually practicable he is forced to conclude that the effects of pathologic processes are customarily such as to facilitate the procedure rather than to render it more difficult.

It is very probable that much of the good effect produced by postoperative lavage of the gall bladder as frequently practiced by those not cognizant of the previously described technique of cholecysduodenal lavage is actually due to reflux of the irrigating solution into the duodenum during the process.

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CHAPTER XIX

PREOPERATIVE AND POSTOPERATIVE CARE OF PATIENTS WITH TOXIC GOITER

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CHAPTER XIX

PREOPERATIVE AND POSTOPERATIVE CARE OF PATIENTS WITH TOXIC GOITER

I. GENERAL COMPARISON WITH RESPECT TO TREATMENT BETWEEN PATIENTS WITH TOXIC ADENOMA AND THOSE WITH EXOPHTHALMIC GOITER

Both patients with toxic adenoma and patients with exophthalmic goiter present essentially the same problems in treatment, except that the former are more easily controlled therapeutically than the latter and, therefore, do not usually cause the same degree of anxiety to the medical attendant. From the practical point of view the especial value of iodine administration in the exophthalmic type of goiter and also the more frequent occurrence of myocardial degeneration in this type of case serves to differentiate the two conditions therapeutically.

In the treatment of exophthalmic goiter iodine is probably always effective in ameliorating the patient's symptoms, providing sufficient dosages are exhibited and providing due allowance is made for the effects of possible previous iodine medication. Failure of a patient to respond favorably to this form of therapy would seem to be sufficient evidence seriously to bring in question the diagnosis of true exophthalmic goiter. With this view, however, not all observers are in agreement: Clute and Mason, for instance, estimate that in about 12 per cent of cases iodine has no apparent effect on the symptoms of exophthalmic cases.¹

In toxic adenoma the effect of iodine therapy is by no means so brilliant; some have observed good results as a rule and advocate the use of iodine in this condition warmly, others, notably Plummer,² have seen resulting increases in basal metabolism and exacerbations of the clinical symptoms in a certain number of cases and accordingly do not favor the use of

iodine at all. In certain cases exophthalmic goiter and toxic adenoma are apparently associated in the same patient, and such cases will, of course, show a degree of improvement under iodine therapy commensurate especially with the exophthalmic goiter component. Cases with toxic adenoma, furthermore, do not usually require the administration of iodine postoperatively even though it has been found of value preoperatively; cases with exophthalmic goiter always do.

Myocardial degeneration is so characteristic of the case with exophthalmic goiter as to constitute an essential part of the clinical picture. Myocardial degeneration may also constitute a part of the clinical picture of the case with toxic adenoma, but when it does the degeneration is regarded as largely coincidental and probably depends somewhat upon the more advanced age period in which toxic adenoma develops.

Since the two kinds of goiter are so closely allied, the treatment of the two types will not be considered separately, but the treatment of the exophthalmic variety will be taken as a type from which variations in the direction of simplification may be made to fit the less severe cases of toxic adenoma.

II. PREOPERATIVE CARE OF PATIENTS WITH EXOPHTHALMIC GOITER

The patient with toxic goiter formerly presented a much more serious problem for the surgeon than such a patient does at present, though it must be admitted at the outset that the care of such cases is still by no means easy, and frequently the resources of the surgeon are taxed to the utmost. The advance in our knowledge of the proper surgical treatment of the thyroid case has consisted not in the elaboration of new methods of surgical technique, but has resulted from a clearer understanding of the pathology involved and a better, though as yet incomplete, knowledge of how to minimize the operative risk by proper preparation and subsequent care.*

* The development of the "stage operation" technique constitutes an exception to this statement, but many surgeons with wide experience in thyroid diseases now find the use of this operative method rarely, if at all, necessary when patients are properly prepared preoperatively.

Perhaps the outstanding contribution to the preoperative as well as the postoperative therapy of these cases is the use of the drug iodine.

A. THE VALUE, MODE OF ADMINISTRATION, AND ACTION OF IODINE: To Basedow, who was one of the first to describe the symptoms of exophthalmic goiter, belongs credit for having initially described the benefits accruing from the use of iodine in goiter. Trousseau, in 1864,³ also called attention to the therapeutic value of the drug. Marine and Lenhart⁴ used potassium iodide with satisfactory results in the treatment of Graves' disease and reported their findings in 1909.

For more than a decade subsequent to this time, however, the use of iodine in the treatment of hyperthyroidism was generally considered to be contraindicated largely because of the untoward results reported by Kocher⁵ in the treatment of simple goiter in 1910. In the more firm and nodular types of simple goiter Kocher⁵ found that iodine caused a rapid development of symptoms of hyperthyroidism, and for this reason, though illogically, he condemned the use of iodine not only in adenoma with hyperthyroidism but also in true Graves' disease.

In spite of the more generally accepted unfavorable attitude of physicians during this period of iodine condemnation, there were some investigators who had the temerity to use the drug. Among these were Loewy and Zondek,⁶ who reported their results in 1922 and were able to show that in 3 cases of Graves' disease oxygen consumption had been reduced to a normal level as a result of the administration of potassium iodide.

In 1924, Plummer and Boothby^{2,7} reported favorable results following the administration of Lugol's solution to 600 cases in doses of 10 minims per day for several days to a fortnight preoperatively; these cases were carefully observed, and two-thirds of them were greatly benefited. In these patients nervous and gastrointestinal symptoms abated, the pulse rate was decreased, and the basal metabolic rate was reduced to within normal limits. The remaining third of the patients

showed lesser degrees of improvement. In seven consecutive months at the Mayo Clinic during the period in which this therapy was on trial there was only one surgical death from exophthalmic goiter and this in a patient who had not been given the treatment.

Rienhoff,⁸ in 1925, added accessory evidence showing the beneficial effect of iodine preoperatively in his demonstration of a histological change from the typical picture of exophthalmic goiter to that of a resting colloid state when iodine was administered for several days. The clinical improvement and the decrease of metabolism were found to be directly associated with this histological change.

As already mentioned, previous to 1923 the administration of iodine was not commonly practiced in connection with the treatment of the exophthalmic goiter patient, and the performance of preliminary surgical procedures, such as "polar ligation" and the so-called "stage" operation, were frequently necessary in connection with radical thyroidectomy. Since the value of iodine has been appreciated, however, primary thyroidectomy following the use of iodine has become the rule rather than the exception, and to Plummer² belongs much of the credit for having established the fact that following the administration of fairly large quantities of iodine, the operation of thyroidectomy usually requires no general anesthesia, and the operation itself is considerably simplified by virtue of the fact that the glandular tissue becomes much less vascular and friable. There is some evidence that the secretion of the gland is normalized.

The degree of postoperative reaction can also be very largely controlled by the preoperative use of the drug, although the usual precautions in the preoperative care of exophthalmic goiter patients cannot, of course, be neglected, or can the use of iodine restore a badly decompensated heart to normal or effect the degenerative process that comes with age in such a way as to make the patient a more favorable risk.

To patients with exophthalmic goiter iodine is usually administered in the form of Lugol's solution:

Iodine.....	grains 20
Potassium iodide.....	grains 30
Water to 1 oz.	

This mixture contains 5.79 mg. of available iodine to the minim.

Lugol's solution is not, however, the only form in which iodine may be satisfactorily administered; certain other preparations are probably equally efficient, because it is the available iodine in the solution used, rather than any other characteristic, which is the important factor.

Following the suggestion of Rabinowitz,⁹ Clute and Mason¹ of Lahey's Clinic have used a hydriodic acid-iodine solution with entire satisfaction, and regard such a preparation when used in doses of 60 minims daily of equal efficiency with Lugol's solution when used in doses of 30 minims daily.

No absolute uniformity of opinion exists as to the proper dose of iodine. Perhaps 30 minims of Lugol's solution daily is as often given as any dosage. Because Cattell¹⁰ found that when a single dose consisting of 30 minims of Lugol's solution was given (250 mg. of iodine), 60 to 80 per cent of the drug was excreted during the first twenty-four hours, and traces persisted in the urine for several days thereafter, he believed that the ordinary dose of 10 minims thrice daily was excessive. Clinical results, however, do not substantiate this conclusion in the experience of many observers, although Marine,⁴ Lowey,⁶ Zondek,⁶ and Neisser¹¹ used smaller amounts with success. Of course, it does not necessarily follow that because a drug is excreted that it has been of no value during its sojourn in the body tissues. Furthermore, there is no evidence to substantiate the contention that iodine in the usual dose or even in much larger doses is actually harmful. Certain cases which do not improve satisfactorily on 30 minims of Lugol's solution per day will be found to show much more satisfactory results when given 60 minims per day.

In cases in which a patient has received doses of iodine for a number of months preceding the contemplation of an operative procedure, and thereby has developed tolerance to the drug the dose must be greatly increased to be effective, even up to 120 drops or more a day. Perhaps there will be found in any considerable series of cases certain ones having received iodine for periods so long that the production of artificial remission by this means is no longer possible at all.

Under active iodine therapy patients characteristically show the most marked clinical improvement at the end of the first eight or ten days, but when operated upon at this time do not seem to withstand the effects of operation as well as when the preparatory period is extended for several days longer; in general, maximum improvement from the point of view of operative safety is secured only at the end of a period of two weeks.

The clinical improvement consists of (1) disappearance of nervousness, restlessness, tremor, and shakiness, (2) disappearance of the staring or frightened appearance, occasionally though infrequently, recession of the exophthalmos, (3) diminution of perspiration and the sensation of heat, and (4) abatement of ravenous appetite in patients so afflicted, or return of normal appetite to patients previously suffering from anorexia.

B. CLASSICAL PREOPERATIVE CARE: To G. W. Crile¹² belongs much of the credit for having enunciated, reiterated, and popularized the general principles of preoperative and postoperative care of the toxic thyroid case, and no account would be complete without a résumé of the type of treatment which he has advocated and which has come to be regarded as fundamentally sound.

At Crile's Clinic emphasis is placed on getting the patient to the hospital and preparing her for operation with as little psychical disturbance as possible. To this end preliminary business arrangements are disposed of in advance of the advent of the patient to the hospital so that she may be received by the

nurses and attendants, weighed, and put to bed with an absolute minimum of routine and delay. Once the patient is in bed she does not get up again until after the operation. The first day in the hospital is a day of acclimatization, and the patient is visited by the surgeon in attendance only in a casual way for purposes of getting acquainted. Only on the second day is an attempt made to obtain a record of the history of the case and the physical findings, and even then if the patient shows any signs of fatigue the examination is stopped forthwith, to be resumed only after a sufficient interval has ensued to allow the patient to regain her psychic and physical poise. The condition of the myocardium is ascertained with particular care, and if any sign of myocarditis is noted digitalization is instituted at once, 20 minims or less of the tincture every four hours being used for from 8 to 12 doses, or until maximum restoration of the myocardium has been effected. The kidney function is determined in the average case by means of the Mosenthal technique, since this involves a minimum of disturbance to the patient; but in cases which show evidence of actual nephritis a phenolsulphonephthalein test is made by intramuscular injection of the dye, and operation is delayed and treatment is instituted until the output of the dye is at a safe level. This treatment consists of rest in bed, forcing of water by mouth, subcutaneous infusions of $\frac{1}{32}$ per cent of novocaine solution (Bartlett) in normal saline solution, glucose and sodium bicarbonate in 10 per cent solution by rectum, and the reduction of proteins and salts in the diet to a minimum; frequently the dietary treatment takes the form of a simple milk diet. If there is retention of fluids with edema hot packs are also used.

The treatment of the insomnia, of which patients with toxic goiter so frequently complain, consists of the administration of 30 grains of sodium bromide every evening at eight o'clock.

It is considered good practice to anticipate a possible reaction resulting from sudden diminution of thyroid secretion as the result of thyroidectomy by administering 2 grains of

thyroid extract the night before and the morning of operation. It is believed at the Crile Clinic that the cycles of vomiting, tachycardia, restlessness, and delirium, usually described under the term "hyperthyroidism" are due to an intracellular acidosis, the treatment for which consists of digitalization as previously described, blood transfusion, and subcutaneous infusion of from 3000 to 5000 c.c. of normal saline solution every twenty-four hours.

Crile advises that the time of the operation be not revealed to the patient and that all preparations for operation be made daily beginning with the second day of the patient's stay in the hospital just as if the operation were to be done that day, except that sterile water is used for hypodermic injection instead of morphine and atropine, and anesthesia with the nitrous oxid-oxygen machine is not allowed to progress to the point of loss of consciousness; operating-room clothing, pneumonia jacket, and leggings are, however, supplied during the dummy preparations. On the day of the actual operation morphine and atropine are substituted for water, and anesthesia is carried to the stage of unconsciousness, whereupon the operation is then either completed in the patient's room or the patient is carried to the operating theater, depending upon circumstances.

C. PERMISSIBLE DEVIATIONS FROM THE CLASSICAL PRE-OPERATIVE CARE: As has previously been stated this outline of preoperative therapy is fundamentally sound, and the only possible argument which can be directed against it is the argument of expediency. Although probably no essential feature of this program can be neglected with impunity in the severe case, unless possibly the elaborate system of dummy operations culminating in an unexpected real one, a procedure also called "stealing" the gland, there are undoubtedly many cases of less severe type in which prolonged preoperative hospitalization and a rigorous, prolonged, preoperative regime of acclimatization are not possible, necessary, or even advisable. Intelligent and cooperative patients, whose symptoms are not

too severe and whose financial resources are not adequate to cope with the expense of a considerable hospital bill, may be instructed how to take care of themselves at home during most of the preparatory period, which in the average case is not less than two weeks. They should be impressed, however, with the fact that strict rest in bed is of primary importance and that rigid adherence to the other items of treatment indicated in the particular case can alone obviate the enforcement of these regulations for a prolonged period in the hospital at a later date, providing subsequent examination proves that the home treatment has been inadequate. Three days of preoperative rest in bed in a hospital is probably a minimum requirement in such cases, and during this period a thorough investigation of the patient as an operative risk should be made, a complete history taken for record, and any special laboratory examinations not previously made should be completed.

D. THE VALUE OF BASAL METABOLISM DETERMINATIONS: The place of basal metabolic studies in connection with the preoperative care of toxic goiter cases is a somewhat mooted question. It should be emphasized, however, that with the clinical methods commonly available the accuracy with which the basal metabolism can be computed is not very great, a 10 per cent error probably being of no infrequent occurrence, and consequently small variations either from normal or from previous determinations should not be too closely construed. All in all, it is probably true that such determinations are of far greater value in differential diagnosis in obscure cases than they are as an index to the progress of patients under active therapy. The general condition of the patient, especially the pulse rate and the emotional stability, are probably far better prognostic guides to the experienced thyroid surgeon than any attempt to measure metabolism, though such a statement must be construed as casting no unfavorable reflections on the metabolimeter as an instrument or the intelligent use of it in the toxic goiter case, especially for those of less experience who

will often require as much help as possible from all sources in treating a case of any considerable severity. Rest in bed and administration of adequate doses of iodine for a period of from eight to ten days preoperatively usually decreases the basal metabolic rate of patients with exophthalmic goiter by about 18 per cent; but the amount of absolute decrease in metabolic rate is of less significance than the uniformity of decrease when daily readings are compared.

E. THE VALUE OF FORCED FEEDING: There remain to be emphasized several factors of particular importance in the general care of the exophthalmic case.

Perhaps the outstanding pathology consists of increased metabolism, and naturally this means the utilization of abnormally large quantities of both food and water; in order to maintain the weight and nutrition of a patient, it is, therefore, of the utmost importance that both foods and fluids be supplied in unlimited quantities and that the diet be selected from substances of high caloric value. If the patient can take extra meals these should be supplied without stint, and it is well even in the absence of craving for nourishment to tempt the patient's appetite between meals with easily digested preparations such as whole or prepared milk, egg-nog, and ice cream. Tea, coffee, and tobacco are, of course, prohibited because of their stimulating qualities.

F. THE VALUE OF SEDATIVES: The apprehensive and irritable patient requires the exhibition of sedatives to the extent of complete control of anxiety or even mild somnolence. In the average case no drug serves quite as well for this purpose as bromides in relatively large doses; 60 grains of "triple bromides" is not a particularly large dose. In the event that the patient exhibits an idiosyncrasy to bromides, veronal, and even luminal, may be used, but these are distinctly less desirable drugs, especially the latter which is essentially a depressant of motor activity rather than of the psychic functions.

G. THE VALUE OF PREOPERATIVE X-RAY IRRADIATION: Although the use of x-ray radiation of the thyroid is a thing

of the past as far as accepted therapy is concerned the administration of a single dose of such irradiation may occasionally serve as a valuable preoperative adjunct to thyroidectomy in the severest forms of the disease. Naturally, if invoked, this form of treatment should be administered only by a thoroughly competent radiologist. The maximum benefit may be expected from such therapy in from ten days to two weeks.

III. GENERAL POSTOPERATIVE TREATMENT OF EXOPHTHALMIC GOITER PATIENTS

The more recently adopted preoperative care of toxic thyroid cases, as has just been described, has done much to minimize the complications of the postoperative period, but the care of these cases is often a serious matter notwithstanding.

Although most patients perspire freely during their sojourn in the operating room, the thyroid patient usually does so unduly, and a change of garments before placing the patient in bed after such an operation as thyroidectomy becomes a very important matter. This procedure assumes added importance because ice-bags must almost always be used subsequently for the control of body temperature and the effect of cold and dampness together would be not only highly unpleasant from the point of view of the patient's comfort, but also highly undesirable from the point of view of her uncomplicated convalescence. The bed, having previously been warmed by means of hot-water bottles, is arranged to receive the patient in a sitting, or at least a semi-sitting, position. In patients too sick to be placed immediately on a back rest the head of the bed should at least be elevated 10 to 12 in., and the sitting position may be subsequently assumed usually in from ten to twelve hours. The sitting position may be suitable from the beginning, especially in those cases in which the operative procedure has been performed under local anesthesia; pillows are placed under the knees and back of the head, the former to promote comfort and the latter to relax any possible tension on the suture-line

in the neck; additional pillows may and should be banked about the rest of the body in such a manner as to facilitate the completest possible relaxation of the patient's muscles. In most cases it is well to forestall the advent of undue pyrexia by the immediate application of ice-bags; most frequently as many as five will be required and they are best placed external to the sheet or blanket covering the patient, and in close relation with the heart and larger vessels, i.e., one over the precordium, one in each axilla, and one in each iliac fossa.

Morphine is given to the thyroid case, as to other post-operative cases, for the complete control of pain, and, indeed, complete relief from pain is doubly important in such a case because pain and consequent restlessness do much to raise an already unduly high metabolic rate. Bromides are of especial importance as a sedative in thyroid cases but usually cannot take the place of morphine in the earliest postoperative period; bromides are, accordingly, usually reserved until such time as actual pain shall have given way to restlessness.

The administration of iodine in the form of Lugol's solution, or otherwise, to the exophthalmic goiter patient is as important postoperatively, if not more important, than the preoperative use of this medication. The amount given, the preparation, and the method of administration all vary with the patient and the patient's condition. In certain cases the administration of Lugol's solution by mouth and in the same amounts as given preoperatively can be continued into the postoperative period without interruption except for a single dose, or at most two doses. On the other hand, many cases, especially those which are very toxic, cannot take medication *per os*, and these are precisely the cases which ordinarily stand in most urgent need of iodine therapy. Two additional avenues through which medication may be administered are, of course, *per rectum* and by hypodermic. Rectal administration of drugs is, by and large, unsatisfactory because absorption is frequently slow and also frequently incomplete, the latter making necessary the administration of rather larger doses than are needed

when other methods of administration are used. For administration by hypodermic the intravenous route is necessitated by the fact that the active iodine compounds are highly irritating when injected directly into fixed tissues; fortunately, sodium iodide is well tolerated intravenously and acts as a very satisfactory compound for the purpose. About 30 grains of sodium iodide constitute an average dose, and when made up in 10 per cent solution the dose is, accordingly, about 20 c.c.

Jackson¹³ has recently called attention to the possibility of supplying iodine by means of the duodenal tube in such cases as are not able to tolerate iodine by the usual avenues of administration. He advises passing the tube on the afternoon preceding the operation and leaving it thereafter *in situ*, the patient thus being allowed sufficient time to adjust herself to the presence of the tube and to the passing of fluids, nourishment, and iodine into the duodenum before the operative procedure is instituted. The tube is then left in place for forty-eight hours after the operation in the average case, although sometimes it is withdrawn twenty-four hours sooner, and sometimes is allowed to remain one day longer. By the use of the duodenal tube the absorption of adequate amounts of iodine is assured, and postoperative complications in Jackson's hands have been minimized to a very satisfactory degree.

As previously mentioned, the fundamental pathology in hyperthyroidism is elevation of the metabolic rate, and this pathology is not corrected promptly at the time of operation; rather, it is exaggerated for a time afterwards. Administration of Lugol's solution and the exhibition of morphine and bromides are of value because of their pharmacological action, but they do not strike at the heart of the disturbed metabolism. The condition calls fundamentally for an increased fuel intake. It has been estimated on the basis of total respiratory quotient determinations that whereas 18 per cent of a dose of 100 gm. of dextrose is oxidized by the normal individual in two and one-half hours, twice this amount may be oxidized by the patient with hyperthyroidism.¹⁴ The postoperative patient is often

in no condition at first to take, by natural channels, amounts of dextrose sufficient to supply his excess requirements, and under these conditions there occur, first, depletion of the glycogen stores in the liver and later invasion of the proteins and fats. Fifty-eight per cent of the proteins may be converted into carbohydrates, but during the process (1) rapid loss of weight occurs, and (2) the products of protein catabolism, ammonia, and urea, must be eliminated by the kidneys, an added burden. When the fats of the body are involved absence of the proper amount of concomitant carbohydrate catabolism may lead to incomplete combustion, as explained previously in connection with the general subject of acidosis and ketosis, may develop.

The indications are obviously to maintain the supply of carbohydrate food; this may be done partly by oral administration of dextrose in the form of sweetened drinks, such as orange juice and ginger ale, partly by the judicious administration of dextrose by means of the rectal drip, and in emergencies, i.e., the so-called "thyroid storm" by intravenous administration of glucose in 5 per cent solution, 500 to 3000 c.c. in the twenty-four hours.

Since all metabolic changes involve the liberation of heat, another prime requisite in the treatment of a condition such as this with increased metabolic rate is the supplying of adequate quantities of water, the latter constituting the great heat regulating medium of the body. Water is usually supplied along with the dextrose in sufficient quantities in the manner just described.

IV. COMPLICATIONS OF THYROIDECTOMY

Thyroidectomies are usually followed by considerable drainage from the wound for the first twelve hours following operation, and, accordingly, the wound should be dressed at the end of this period and every twenty-four hours thereafter until complete healing is established. Rubber drains are

usually removed at the second dressing and the stitches or skin clips on the third postoperative day.

The postoperative complications which may ensue upon thyroidectomy in toxic cases include:

1. "Acute hyperthyroidism," also known as "the post-operative reaction" or the "thyroid storm"
2. Hyperpyrexia
3. Tachycardia
4. Wound infection
5. Collapse of the trachea
6. Tracheitis and laryngitis
7. Hemorrhage
8. Paralysis of the vocal cords
9. Tetany or "pseudotetany"
10. Myxedema
11. Acute cardiac dilatation and auricular fibrillation.

A. ACUTE HYPERTHYROIDISM: Crile¹² believes that the so-called "post-operative reaction" formerly so often seen and consisting of nausea, vomiting, diarrhea, extreme restlessness, which borders on delirium, and accelerated pulse rate with a rapidly mounting temperature, and occasionally suppression of urine, can be eliminated by, (1) the adoption of nitrous oxid analgesia instead of surgical anesthesia, (2) by minimizing shock and exhaustion by operation in the patient's own room in severe cases, (3) by the avoidance of prolonged operation, (4) by the prevention of absorption of wound secretion, and (6) by the multiple stage operation.

When actually developed the pyrexia is best controlled by the use of ice bags, the original five which are used as a matter of routine being doubled for every degree rise in temperature up to 102°F. When the temperature reaches 103°F. (rectal 104°) a rubber sheet is spread over the mattress and the patient is rolled in another rubber sheet, after which 150 to 200 lb. of cracked ice are heaped up about the patient, an ice bag is put to the head, and an electric fan at the foot of the bed blowing directly on the patient. The temperature

falls in the average case at the rate of about 2° per hour, but the fall of temperature should be checked every twenty minutes to avoid too rapid reduction in the case of susceptible patients. The patient is removed from the ice pack when the temperature has reached 100°F. (101°F. rectal) since a further reduction in temperature may be expected and the development of a subnormal temperature is undesirable.

In administering the ice-pack especial care should be taken to avoid contact of moisture with the patient's skin lest the sheets actually freeze fast to the latter. Chilblains are apt to form on the thighs or abdomen in cases requiring prolonged treatment in such a pack, and it is of the utmost importance to inspect the patient for evidences of such an occurrence as soon as the pack is removed in order that any frost-bitten areas may be rubbed with ice during the process of thawing.

B. TACHYCARDIA: Tachycardia is believed to be of nervous origin and is not a sign of a failing myocardium even in those cases in which there is a fatal outcome.

C. WOUND INFECTION: Wound infection is treated by opening the wound widely, packing with sterile gauze, treatment with hot compresses of hypertonic salt solution, or irrigation with Dakin's solution hourly, and the application of hot sterile dressings to the wound surface between irrigations. A secondary closure is made when sterilization has been effected.

D. COLLAPSE OF THE TRACHEA: Collapse of the trachea occurs as a definite clinical entity and occurs either during the actual operative procedure itself or within a very few hours thereafter; it produces marked dyspnea and leads ultimately to death from asphyxia in the untreated case. The fundamental pathology is a softening or erosion of the cartilaginous rings of the trachea due to pressure atrophy and accordingly is encountered especially in connection with relative large and hard goiters, particularly in those of the nodular type. Previous to operative interference collapse is prevented by the presence of supportive connective tissue trabeculae and adhesions

between the damaged trachea and the tumor mass; when the latter is removed, however, the support being now absent, there is a tendency for the walls of the trachea to fall together during inspiration. Obviously the treatment for such a condition is immediate tracheotomy and the institution of some mechanical measure designed to maintain the patency of the trachea until sufficient adhesions have formed to prevent a further recurrence of the collapse; commonly this latter procedure consists of temporarily fastening a tracheotomy tube in place.

E. TRACHEITIS AND LARYNGITIS: Cases of collapse of the trachea are probably much less frequently encountered than previously supposed, many or most of the cases previously so diagnosed being actually cases of tracheitis or laryngitis. These two complications are secondary to (1) direct operative trauma of the trachea and larynx, (2) interference with the blood supply to these organs, or (3) a combination of both of these factors; there may or may not be present a complicating injury to the recurrent laryngeal nerve. The presenting symptom is dyspnea, which frequently is severe but rarely so severe as to jeopardize the life of the patient; increasing hoarseness occurs *pari passu* and suggests the diagnosis. The fundamental abnormality consists of edema which can usually be definitely observed by means of the laryngoscope; two to four hours are required postoperatively for the development of sufficient edema to cause marked symptoms, and this represents the characteristic time interval noted in these cases. The tracheitis and laryngitis of thyroidectomy usually responds within twenty-four hours to the erection of a steam tent over the patient's bed and the subsequent inhalation of a warm atmosphere saturated with moisture. The administration of some sedative for the initial cough is indicated, usually $\frac{1}{2}$ grain of codeine every fifteen minutes for four doses.

F. PARALYSIS OF THE VOCAL CORDS: Paralysis of the vocal cords is always a matter of grave concern when it occurs, because there is invariably a question as to the cause of the

condition and the consequent prognosis. On the one hand, the condition may be secondary to tearing, cutting, crushing, or inclusion within a ligature of the recurrent laryngeal nerve, all of which conditions characteristically give rise to a permanent paralysis, whereas, on the other hand, it may be resultant upon the pressure incident to edema or upon temporary loss of function due to unwise manipulation, particularly traction, in which cases the paralysis may be expected to disappear completely in one or two weeks. Obviously either one or both recurrent laryngeal nerves may be involved and consequently either one or both of the vocal cords.

Monolateral involvement of the cords may or may not be accompanied by hoarseness or voice changes; in those cases in which voice changes do occur they are usually only temporary and disappear as the remaining cord hypertrophies. Bilateral cord paralysis is a much more serious complication; interference with phonation occurs in two main types: (1) that in which the patient is able to talk but does so with a characteristic "brassy" or cackling quality, which once heard associates itself with cord paralysis, or (2) that in which, although the speaking voice is lost, a loud falsetto whisper is still possible. In the first type there is likely to be early partial obstruction to breathing, a complication which is absent in the second, and this frequently may call within twenty-four hours for the performance of tracheotomy to relieve distressing dyspnea and stridor. In the second type there is much less likelihood of interference with breathing, but the drinking of water causes a most distressing coughing and choking. In both types it is well to be momentarily prepared to perform tracheotomy in cases in which such a procedure may be required, and prophylactically much may be done to minimize such a possibility by the erection of a steam tent by means of which either simple or suitably medicated steam-saturated air may be provided.

G. HEMORRHAGE: Hemorrhage following thyroidectomy occurs characteristically in two main types: (1) the early,

and (2) the late. Early hemorrhage which occurs during the course of the first forty-eight hours may result from a variety of factors, such as initial incomplete hemostasis, the slipping of improperly tied ligatures, diffuse capillary oozing, and the reopening of temporarily thrombosed vessel ends as the result of an infectious process; some vessel, characteristically a relatively small one, becomes eroded and ultimately ruptures. The symptoms of hemorrhage, which occur particularly in connection with the first or early type, are in the earliest stage entirely subjective; the patient complains of tightness in the throat, sometimes described as a "lump in the throat," difficulty in breathing and swallowing, and, ultimately, loss of the power of speech. Symptoms of asphyxia ensue if the condition is not relieved, and these may progress to the actual death of the patient. The treatment consists naturally in any case of hemorrhage of reopening the wound, evacuating any blood clot which may be present, and control of the hemorrhage by ligation or packing according to the circumstances.

H. EDEMA OF THE SKIN FLAP: It is only rarely that edema effects more than the skin flap; it represents temporary interference with blood and lymph drainage from the part and invariably subsides under the influence of hot, wet compresses of hypertonic salt solution.

I. ECCHYMOSIS IN THE REGION OF THE WOUND: Ecchymosis may occur, and it in contradistinction to edema is not confined to the skin flap but may be diffuse over the neck and even down over the chest. The treatment is the same as that of edema, the application of hot moist compresses of hypertonic salt solution, and the prognosis is good except for the danger of secondary infection of the extravasated blood.

J. TETANY: Formerly, in the days when total lobectomy was the operation of choice for goiter, the postoperative development of tetany was of much more frequent occurrence than it is at present. The development of this complication is dependent upon injury to, or removal of, the parathyroid bodies, an accident which is now largely obviated by the

operation of resection which leaves intact the posterior capsule of the gland and approximately an eighth of the total glandular substance attached thereto. Tetany occurs in two forms, (1) the transient, which is dependent usually upon interference with the blood or nerve supply to the parathyroids rather than any direct injury thereto, and (2) the permanent which formerly, as noted just previously, was due to operative removal of these organs, but now is apparently due in those rare cases in which it does occur to permanent interference with the blood supply or other factors not at present well understood. Pseudotetany usually appears in from two to twenty-four hours after operation and is characterized by moderate spasticity of the muscles of the forearms and lower extremities, flexing of the fingers, itching of the finger-tips and nose, and slight circumoral pallor. Spontaneous recovery in from six to forty-eight hours is the rule. Permanent tetany is recognized by the occurrence of typical tetanic contractions of the muscles of the body which commence merely as fibrillary twitchings, but which become progressive in character. Administration of calcium chloride intravenously in doses of 5 c.c. of a 10 per cent solution controls attacks of parathyroid tetany, and a milk diet supplemented by the exhibition of calcium lactate by mouth acts both prophylactically and curatively in eliminating within a few days the transient type of the condition. In the permanent type, which gives cause for greater anxiety, the exhibition of calcium chloride intravenously and parathyroid extract either by hypodermic injection or by mouth, preferably the former, may give symptomatic relief but obviously cannot cure the condition.

K. MYXEDEMA: Thyroid insufficiency with resulting myxedema hardly occurs as the result of the removal of too much tissue operatively nowadays, since the mechanism of the development of such a condition is too well understood and appreciated; in rare cases, however, wound infection and interference with blood supply may give rise to sloughs of otherwise sufficient thyroid residues and cause mild degrees of

myxedema. The treatment of such a complication is, of course, medical and consists of the administration of thyroid extract or its active principle, thyroxin.

L. CARDIAC DILATATION AND AURICULAR FIBRILLATION: Acute cardiac dilatation and auricular fibrillation not infrequently occur in connection with advanced cases of exophthalmic goiter and in adenomatous patients with chronic myocarditis. If prophylactic treatment fails to avert this complication digitalin in $\frac{1}{25}$ gr. doses each hour by hypodermic injection may be tried or strophanthin in a dose $\frac{1}{2}$ mg. in 5 c.c. of sterile normal saline intravenously repeated in fifteen minutes.

V. CONVALESCENT CARE OF THYROIDECTOMIZED PATIENTS

The period of actual postoperative sojourn in the hospital varies from six to twelve days and the period of confinement to bed from two to eight, depending upon the type of goiter, patients with simple adenomas recuperating rapidly, those with exophthalmic goiters much more slowly. On discharge patients are told that their condition has been improved and that complete recovery may be expected to ensue after an interval of some months.

There is apparently no uniformity of opinion as to the length of time after thyroidectomy during which administration of iodine should be continued. The rationale of postoperative iodine therapy is, however, sound and is based on the experimental studies of Halstead and Marine. Halstead¹⁵ showed in 1896 that in dogs which had been subjected to partial thyroidectomy compensatory thyroid hyperplasia subsequently occurred, and Marine and Lenhart¹⁶ repeating Halstead's experiments were able to show (1) that this hyperplasia did not occur until the iodine store in the remaining portion of the gland had fallen below 0.1 per cent, (2) that when compensatory hyperplasia occurs it occurs in proportion to the decrease of the iodine store, and (3) that as much as three-quarters of the normal gland could be removed without

the development of subsequent hyperplasia providing small doses of iodine were given postoperatively. Iodine is therefore apparently of value in the prevention of postoperative thyroid hypertrophy and is given with that purpose in mind.

Clute and Mason¹ have used with satisfaction a dose of 10 drops of Lugol's solution weekly. If at the end of a period of three months satisfactory improvement has been made the drug is then discontinued; otherwise it is continued for a longer period. In cases in which patients are subjected to a multiple stage operation these authors prescribe 10 minims daily for a period of six weeks between stages.

Many authorities advise continuation of iodine therapy for at least six months, the dose depending upon indications, and many authorities preferring alternating periods of active therapy with periods of rest.

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CHAPTER XX

PREOPERATIVE AND POSTOPERATIVE CARE OF GASTRIC CASES

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CHAPTER XX

PREOPERATIVE AND POSTOPERATIVE CARE OF GASTRIC CASES

I. PREOPERATIVE TREATMENT OF GASTRIC CASES

A. THE IMPORTANCE OF GENERAL AND SUPPORTIVE CARE: The general condition of the patient requiring gastric surgery is usually of far greater importance preoperatively than any other consideration, and frequently the exigencies of the case require that the amelioration of this condition take precedence over everything else. To concentrate upon operation to the exclusion of general treatment in a patient the victim of pyloric obstruction in whom excessive vomiting, gastric dilatation, and toxic absorption were prominent features of the case would be to court almost certain disaster.

Preoperative care in gastric cases is of special importance in patients with obscure gastric disorders or those in whom the gastric disorder is complicated by other pathology, in patients who have undergone previous operative procedures, in those with recent and extensive gastrointestinal hemorrhages, in patients with pyloric obstruction and gastric retention, and in patients with carcinoma, especially those presenting cancerous cachexia. Cooperation between the internist and the surgeon has proved of the greatest prophylactic value in connection with gastrointestinal lesions complicated by gastric retention or obstruction.

B. LOCAL PREPARATION OF THE GASTROINTESTINAL TRACT: It is considered necessary or desirable by some surgeons to attempt to sterilize the lumen of the stomach previous to operations on this organ, the technique consisting of scrupulous oral hygiene for a few days combined with the ingestion of sterile food only.

Finney¹ who is an ardent advocate of the method describes his regime thus:

For several days previous to the operation the patient is instructed to brush his teeth thoroughly with an antiseptic toothpaste and rinse the mouth with a 1 per cent carbolic acid solution several times a day. For the same length of time he is kept on a sterile diet, i.e., cooked foods, pasteurized or boiled milk, eggs, orange juice, boiled water, etc. If there is gastric stasis, lavage once or twice a day, depending upon conditions present, should be employed. Repeated observations by various authors, notably Cushing and Livingwood, observations that have been abundantly confirmed by cultures taken by me from both stomach and duodenum upon the operating table, have convinced me that the acid stomach will sterilize itself in approximately forty-eight hours, if no infectious material is meanwhile ingested. However, this rule does not apply in case of ulcerating carcinomata of the stomach walls. In the latter condition various forms of bacteria have been recovered, especially the streptococcus pyogenes.

Although attempts to reduce the number and virulence of bacteria in the upper gastrointestinal tract by means such as these are highly rational, it would, however, seem that even the most ardent advocates of the method admit that the procedure is not altogether effectual in those cases in which it is most desirable. The acid stomach sterilizes itself readily without aid, and the abnormalities which the surgeon must treat in an organ, the seat of normal or excess acidity, are for the most part relatively simple, usually not more than gastro-enterostomy; the stomach lacking in acidity is apt to be the seat of carcinoma, for the adequate treatment of which radical surgery alone will suffice. Furthermore, a fairly large number of cases requiring gastric surgery are *in extremis*, due to abnormal conditions such as ruptured gastric ulcer and stab or gunshot wounds of the abdomen; in such cases attempts at sterilization are, of course, out of the question because of the urgent nature of the operative indications. Furthermore, the absolute sterilization of the oral cavity is never accomplished, and since patients are continually swallowing saliva from a contaminated mouth, sterilization, though perhaps measurably complete, cannot ever be absolute. Therefore, it can be taken as a working principle that if time can safely be spared for the purpose, an attempt to sterilize the stomach

and the upper intestinal tract will certainly do no harm and may occasionally be of much value; but the fact that such an attempt has been made should in no case be allowed to provoke a sense of false security either in the conduct of the operation itself or in the consideration of postoperative complications thereafter.

II. POSTOPERATIVE CARE OF GASTRIC CASES

The two principal indications following gastric operations are: (1) the maintenance of the fluid intake at as near a normal level as possible, and (2) the administration of sufficient food to take care of the body requirements of the convalescent patient. The treatment follows the lines laid down for other operative cases in most essential details. There is, however, an especial indication in these cases to keep the gastrointestinal tract free from peristalsis for a period of at least four days in order that undue tension be not exerted on the intestinal suture-line and accordingly no loosening of sutures and consequent hemorrhage or leakage may result.

A. MECHANICAL CHARACTERISTICS OF INTESTINAL WOUNDS: It has been shown experimentally by Chlumsky² and later corroborated by Cutting³ that in carefully sutured intestinal incisions the period of maximum mechanical weakness is not the period immediately following the surgical procedure. At this time, determinations have shown, the suture-line is capable of withstanding approximately one-third the pressure required to rupture the intact intestinal wall, a pressure which is relatively considerable. As time goes on, however, a progressive weakening of the suture-line becomes evident, which is presumably due to a process of autolysis or pressure necrosis in the region of the sutures; this effect becomes maximal about the end of the third day, at which time the suture-line is frequently less than half as strong as it was originally. Proliferation of connective tissue begins to make its reinforcing properties manifest about the fourth day, however, and from this period on a rapidly progressive increase in mechanical

strength occurs. The period of particular danger from rupture of the intestinal wound is, accordingly, the second, third, and fourth postoperative days. It is for this reason that insistence is placed on as near complete rest as possible for the digestive tract during the first four days.

B. THE USE OF THE STOMACH TUBE: The stomach tube is usually indispensable in the proper care of gastric cases in the early postoperative hours as a means of emptying the organ of blood and other secretions. The regurgitation or vomiting of blood or blood-tinged material is an indication for immediate gastric lavage, and the attendant who does not hesitate to pass the stomach tube in the presence of such minor indications as increased pulse rate and anxious facies will usually be amply justified in his action by the subsequent favorable development of the case. Unless the stomach contains blood clots gastric lavage is usually best performed through a tube of the Levin type, the latter being passed into the stomach either through the mouth or the nose, a 2 per cent solution of sodium bicarbonate warmed to 110° F. being used as a vehicle, and all manipulations being performed with gentleness. In case it should appear probable that subsequent lavages will be needed, the tube may be left in place suitably attached to the cheek with adhesive plaster and used over and over again as required; lavage may be indicated as often as every two hours in many instances.

C. THE INITIAL PERIOD OF FASTING: In accordance with the teachings of Balfour⁴ and others, patients having undergone operations as serious as gastric resection should be denied anything at all by mouth for the first four postoperative days. Adequate fluid intake must be maintained, however, by means of proctoclysis either solely or in combination with hypodermoclysis. In order to minimize the possibility of the development of acidosis during this regime, at least small amounts of glucose should be incorporated in the fluid used for proctoclysis or hypodermoclysis, and correspondingly larger amounts may be useful in providing energy and thereby

preventing undue catabolism of the patient's own tissues. Patients much debilitated by some underlying morbid condition, e.g., those who have suffered from intestinal obstruction for some time and who perhaps also may have in addition a carcinomatous cachexia, present especial indications for the maintenance of intestinal quiescence, and such period of quiescence should be prolonged for at least an additional twenty-four hours, since in such patients the healing process is especially slow and difficult. Balfour⁴ believes that in these cases and others in which danger from intestinal leakage is anticipated the use of morphine to the point of maximum tolerance may prove a life-saving measure. Morphine in $\frac{1}{4}$ grain doses every two to three hours until the respirations have been reduced to 8 to 10 per minute will usually completely suppress intestinal movements according to Balfour.

D. THE INSTITUTION OF FEEDING: On the fifth day in favorable cases the gradual resumption of food intake by mouth may be commenced with the giving of such bland, nourishing fluids as broth and albumin-water in amounts not to exceed 1 oz. every one or two hours. One ounce of a mixture of equal parts of milk and cream may be substituted for the foregoing substances in favorable cases with advantage, because of the added nutritive value of such a mixture. Such feedings should, however, be supplemented by the administration of 15 grains of a mixture of equal parts of sodium bicarbonate and magnesium oxide fifteen minutes before each feeding to neutralize gastric acidity and provide a mild laxative action. Calcium carbonate in 10 grain doses flavored with $\frac{1}{40}$ minims of oil of cinnamon may be used as an alternative to the sodium bicarbonate magnesium oxide powder.⁵

The value of alkali therapy postoperatively should be especially emphasized in connection with cases of hyperacidity. Carlson⁶ has shown that the presence of an undue degree of acidity in the stomach predisposes to pylorospasm and thus tends to aggravate the symptoms of which the patient characteristically complains, and the weight of opinion

of both surgeons and internists seems to incriminate acidity as a factor in the formation of gastrojejunal ulcers. Experimentally, Mann and Williamson⁷ have been able to produce such ulcers in animals by diverting the alkaline secretions which normally neutralize the acid gastric juice, and Dragstedt and Vaughn⁸ have shown that the healing of artificial ulcers in animals is hastened by the neutralization of acidity with suitable amounts of alkalis. The inhibition of pylorospasm and the degree of physiological rest to the part thereby secured is presumably of value in inducing the healing of ulcers in this region.

The feeding of patients on the sixth and subsequent days, fortunately or unfortunately becomes for the most part a matter of individualization. Semisolid foods, such as junket, oatmeal, and jelly, may usually be permitted on the sixth day; 2 oz. may be allowed, and feedings may be permitted every two or three hours. If the milk-cream diet is preferred it may be given in amounts of 2 oz., preceded as before by the administration of an alkaline powder and without increasing the time interval between feedings. On the seventh day slightly more latitude may be allowed in the diet in favorable cases by the addition of custard, blanc mange, or even a soft boiled egg, and in those cases in which milk or cream has been previously denied these substances can be added to the dietary at this time, always, however, with the addition of 15 grains of alkaline powder or 1.5 oz. of lime water given a few minutes before the feeding. The total amount of the feedings may be increased to 3 or 4 oz. After the first week the diet may usually be still further augmented both in amount and in variety. Six or eight ounces may be allowed at a time. Stale bread, apple sauce, cream of wheat, cream soups, baked or mashed potato, and chicken or meat jelly, without the meat, are suitable substances.

If at any time during the period of building up the diet a sense of undue fullness or distress occurs or any other untoward symptom develops, feedings should be temporarily discon-

tinued or at least the feeding regime of a preceding day should be temporarily adopted.

In outlining the diet of the individual case prudence dictates that counsel should be taken with dietetic specialists whenever possible, and that surgical attendant is wise who not only makes a special study of this branch of medicine for himself but who cultivates connections such that he will be in a position to receive frequent counsel and advice in the care of individual cases which come under his care.

An especial point has been made with respect to the observation that following gastroenterostomy regurgitation of alkaline succus entericus into the stomach occurs almost immediately, and the strongly acid reaction of the stomach contents is accordingly very rapidly reduced. Such is not the case after the operation of pyloroplasty, however, in which case usually about two months are required for gastric acidity to return to normal in cases in which it has previously been high. This means that for a period of eight weeks postoperatively in the latter group of cases unusual care must be given to the dietary regime in order that acidity may be controlled.

E. INTERDICTION OF TOBACCO: It has been suggested that the use of tobacco be interdicted especially in patients having undergone operations for gastric and duodenal ulcers.

Eusterman⁹ is convinced that the use of tobacco is particularly harmful for the patient with peptic ulcer. He believes with Wagner¹⁰ that all the subjective and roentgenographic signs of duodenal ulcer can be produced by the excessive use of tobacco alone and sees an explanation for this in the paralytic action of nicotine on the synapses of the sympathetic nervous system. He is of the opinion that the definitely better end-result seen in the case of women with peptic ulcer, whether under surgical or medical treatment, is explained largely on the basis of the fact that women much less frequently than men are addicted to the nicotine habit. With this view not all authorities are in agreement.

In an attempt to elucidate the possible etiological relationship between tobacco smoking and the development of peptic ulcer Barnett¹¹ examined carefully the records of 439 cases of peptic ulcer seen at the Peter Bent Brigham Hospital between the years 1913 and 1926. By comparison of these histories with the histories of 500 control cases he was able to conclude that smoking seems neither to predispose to the development of peptic ulcer nor to influence the age period in which such ulcers develop.

F. DIETARY RESTRICTIONS IN LATER CONVALESCENCE: There is some difference of opinion as to the extent to which postoperative dietetic restriction should be placed in the later period of convalescence on patients who have undergone operations designed to relieve gastric pathology. Balfour¹² is of the opinion that there is a very real danger of exchanging functional gastric disturbances for organic ones in cases subjected to a too rigorous regime. Eusterman⁹ believes that medical supervision for four to six weeks after operation is capable of relieving disturbances of functional origin, but that there is no real evidence that such treatment can or does prevent the formation of secondary gastrojejunal ulcers, and he mentions that it is often surprising how well patients often do in the absence of all dietary restrictions. In the moderately early postoperative period the restriction of diet to easily digestible foods and the prohibition of highly seasoned and fried foods, condiments, alcoholic stimulants, and at least strong tea and coffee, is rational.

III. POSTOPERATIVE GASTRIC COMPLICATIONS

With respect to the development of postoperative complications in gastric cases, those operations involving the more radical types of gastric surgery are, of course, most likely to give cause for anxiety. Of these the various types of gastric resections by whatever technique, the pyloroplasties, and the gastroenterostomies may be mentioned particularly. The postoperative convalescence of cases undergoing such pro-

cedures is also characteristically prolonged even in the absence of complications.

The chief complications to be recognized and treated are:

- A. Hemorrhage
- B. Shock
- C. Dilatation of the stomach
- D. Gastric obstruction
- E. Postoperative gastric tetany
- F. Diarrhea
- G. Peritonitis

A. HEMORRHAGE: Hemorrhage is the earliest and one of the more common complications of gastric operations. It is usually noted within the first forty-eight hours.

With respect to the occurrence of hematemesis in gastric patients postoperatively, it is interesting to note the relative infrequency with which patients complaining of this condition preoperatively show evidence of chronic intrinsic gastric lesions on the operating table. Though it is, of course, important to exclude lesions of the stomach in any postoperative instance of hematemesis the possible coexistence of extragastric conditions, such as hemophilia, cirrhosis of the liver, chronic cholecystic disease, and splenic disease should also receive consideration before the stomach as such is finally incriminated.

The vomiting of small amounts of blood within the first few hours following the completion of a gastric operation is not of any particular moment. It is usually due to the presence of such residual blood as may have found its way into the lumen of the stomach during the course of the operation, or to a very slow capillary oozing along the suture-line subsequent to the operation. These two types of bleeding are usually controlled by the natural clotting process of the blood within a very short time.

The vomiting of any considerable quantity of bright red blood, however, should always give cause for anxiety. The onset of such hemorrhage is frequently secondary to straining

due to vomiting or coughing, and represents usually the slipping of a ligature, the tearing of a suture, or the dislodgment of a protective blood clot at the suture-line. In this type of hemorrhage vomiting of bright red blood and of large clots occurs every few minutes or at intervals of many minutes to an hour. The stomach in these cases is unable to empty itself in the normal manner through the pylorus or gastroenterostomy opening, as the case may be, as fast as it fills, and irritation of the stomach wall gives rise to the vomiting reflex.

Four general methods of treatment have proved of value in these cases:

1. The simplest and often the least effective is by sedation, i.e., the application of ice bags to the epigastrium and the administration of morphine. Cold applications over the stomach area are undoubtedly somewhat sedative and may prove of value in those cases in which hemorrhage is slight and the stomach unduly irritable. Morphine is indicated in relatively large doses not only to control the patient's apprehensions but actually to quiet his bodily movements.

2. In cases not responding satisfactorily to the latter treatment repeated gastric lavage with water at a relatively high temperature (120°F.) may frequently bring hemorrhage under control. During the first two operative days this procedure, if carefully performed, is without danger; on the third and early the fourth day, however, exceptional care in passing the stomach tube and especial care to prevent overdistention of the viscus should be employed, since, as previously mentioned, at this period the suture-line is weaker mechanically than at any other time during the healing process.

3. In those cases in which hemorrhage is relatively severe, blood transfusion may prove of life-saving value, and precious time should not be wasted in experimenting with intravenous infusions and calcium therapy. The latter forms of therapy are, however, not without value in the milder cases and those in which immediate blood transfusion may be impossible.

4. As a last resort secondary laparotomy may sometimes be required for purposes of repairing the bleeding area.

B. SHOCK: This complication occurring in connection with gastric cases is usually a reflection upon the technique used in the course of the operation, since shock relatively infrequently follows operations performed at the hands of skilful and experienced surgeons. Shock is, of course, more apt to supervene in cases in which preoperative dehydration and debility are pronounced. Shock may be mild and tend to pass away rapidly or it may be more marked and more persistent.

The symptoms are the same as the symptoms of shock from any other cause. The picture is one of rapid feeble pulse, slow and shallow respiration, cold, clammy skin, and profuse perspiration. In mild degrees of shock elevation of the foot of the bed, application of external heat to the body by means of hot water bags or electric heating pads, and the administration of a hot enema usually suffice to bring about reaction within an hour. In those cases in which shock is thought to be associated with or secondary to loss of blood an immediate transfusion, or at least an intravenous infusion, may prove a life-saving measure.

C. DILATATION OF THE STOMACH: As this complication has already been fully discussed in a previous chapter, there is no need for further discussion here.

D. GASTRIC OBSTRUCTION: Possibly the most important and most frequent complication of gastric surgery is the development of gastric obstruction. It may be (1) temporary or permanent, (2) partial or complete, (3) functional or mechanical.

This complication does not ordinarily occur within the first twenty-four hours but may occur at any time subsequently, the most frequent time of onset being from the seventh to the twelfth postoperative day. The symptoms are often obscure, consisting in the earliest stages of a feeling of fullness after eating and the medical attendant gets the general impression that the patient is not as well as on previous days. Not in-

frequently the first actual symptom of the beginning of gastric retention is hiccup. The causes of gastric retention, or obstruction, are perhaps most commonly inflammatory edema around the stoma of gastroenterostomies, twists or kinks in the loops of gastroenterostomies, an inadequately small stoma, malplacement of the gastroenterostomy opening, constriction of a stoma due to contraction of scar tissue, and the development of peritonitic ileus.

The treatment is fundamentally prophylactic, as will readily be realized from a consideration of the previously mentioned causes of the condition. Early recognition of the development of the complication with the prompt institution of gastric lavage frequently aborts the development of a serious condition. Lavage should be performed in these cases at least twice a day, and the amount of material recovered from the stomach should be measured. In case this amount is more than 500 c.c. lavage should be repeated at least every six hours. Everything should be withheld by mouth for at least twenty-four hours, and the fluid intake of the body should be maintained in the interim by the administration of 2000 to 3000 c.c. of a solution of 2 per cent sodium bicarbonate and 5 per cent dextrose by proctoclysis. If, for any reason, this procedure is not well tolerated or is contraindicated, hypodermoclysis or intravenous infusion may be substituted. If the treatment be successful at the end of twenty-four hours, small amounts of tea, broth, and gruel may be allowed by mouth in an attempt gradually to build up a minimum diet, but during this process the material vomited and withdrawn by stomach tube should be carefully measured and subtracted from the total fluid intake with the object of ascertaining how much of the total intake passes the pylorus. It must not be forgotten that changes in the blood occur in this type of obstruction as in any other case of high ileus and that lowering of plasma chlorides, increase in blood urea, and decrease in the carbon dioxide combining of the blood, i.e., alkalosis, may be expected in severer degrees of this complication.

Though the treatment here outlined succeeds in perhaps the majority of patients, there still remains a certain number who are not relieved and who become progressively worse. In the severe types of cases the question of secondary operation becomes an important one. It must be remembered, however, in this connection that usually such patients have been either partially or totally obstructed for a number of days, have become undernourished and dehydrated in the meantime, and have lost both weight and strength. There is also a blood chloride deficiency and an alkalosis, and under such circumstances operative procedures cannot be undertaken lightly. If operative procedures be undertaken, the indications are for a rapid operation under local analgesia and the simplest and most direct type of operative manipulation. In many of these cases the resourcefulness of the surgeon is taxed to the limit, and in a very large proportion of cases, whatever the operative manipulation attempted, a lethal outcome is unavoidable.

E. POSTOPERATIVE GASTRIC TETANY: Gastric tetany is an infrequent complication, and when it does occur it is always in connection with gastric obstruction. The treatment, therefore, is mainly prophylactic, and consists of the prevention of obstruction.

The symptomatology in a case of this condition is definite. The pulse is weak; the respiration is shallow; in the majority of cases convulsions develop which are characterized by clonic muscular contractions. A condition of drowsiness precedes the development of these symptoms, and a condition of coma or semicoma usually follows. The blood findings are the same as those in obstruction, and treatment consists in the rectification of the blood picture by the administration of quantities of sodium chloride, sufficient to raise the blood chloride content to normal. This form of tetany is an alkali tetany and is secondary to the condition of alkalosis. The administration of chlorides is, therefore, specific.

F. DIARRHEA: Severe diarrhea following abdominal operations is a relatively infrequent complication but one which occurs occasionally and may occur in so severe a form as to cause the patient to succumb very rapidly unless efficient treatment can be instituted. It is not very infrequent to encounter a case in which postoperative diarrhea assumes seriousness not unlike that of the diarrhea of cholera, and in which this complication rapidly becomes uncontrollable. Many of the serious cases which have been reported in the literature apparently follow operations on the stomach and pylorus, such as gastroenterostomy, partial gastrectomy, gastrostomy, pylorectomy, and pyloroplasty. Anschütz¹³ collected from 500 gastric operations about 30 cases of postoperative diarrhea. These occurred usually between the sixth and seventh days after operation, and a considerable number of them in connection with malignant conditions of the stomach. Anschütz thinks that the complication of diarrhea occurs most commonly in connection with gastroenterostomy with a short loop, in operations in which the stoma is placed too low in the jejunum, and also after reestablishment of the normal continuity of the gastrointestinal tract in a Billroth No. 2 operation. He is inclined to believe that too rapid emptying of the stomach through the stoma favors the development of the condition.

The appearance of diarrhea, however, is by no means always associated with the presence of a gastric juice which is not acid, or with gastrointestinal fermentation, or with a stoma placed too low in the small intestine. Most of the continental authors believe that too rapid emptying of the stomach is a causative agent in the development of the diarrhea, and they have seen the complication most commonly in cachectic individuals, victims of malignant disease.

Moynihan¹⁴ says that in his experience only 1 case of this complication in a patient in whom the diarrhea lasted as long as five days has recovered. He is of the opinion that no adequate explanation of this complication can be given.

Troell¹⁵ reported 11 cases in patients with peptic ulcer. Four of the patients had had gastroenterostomy; 3 had had gastric resection; and 3 pyloric exclusion and gastroenterostomy. One patient had received segmental resection plus gastroenterostomy. Bierende¹⁶ reported 7 cases in which diarrhea developed in from two to six days after operation. Six of his cases showed peritonitis, and the third case was one of suppurative perinephritis. All of his patients died. Goldschmidt and Muelleder¹⁷ were able to collect 3 fatal cases of diarrhea from 273 stomach operations; 10 cases in all developed the complication. Undoubtedly there are certain cases of postoperative diarrhea which are mild and transient, and which usually occur early in the course of convalescence. These are probably due to changes to full or improper diet or to the institution of too drastic purgation.¹⁸ Possibly the factor of too large a stoma is frequently a cause of the most severe types of diarrhea, but cases have been reported in which such is obviously not the case, whereas diarrhea develops in some operations for ulcer of the stomach in which no associated gastroenterostomy has been performed and in other cases following operations, such as pyloroplasty and the reestablishment of normal continuity of the gastrointestinal tract. Beer¹⁸ has reported 5 cases of perforating intestinal ulcers with peritonitis in which uncontrollable and apparently unexplained diarrhea developed during an otherwise satisfactory convalescence. In 2 of his cases an anastomosis had been performed and in 3 simple closure of the perforation had been attempted. Beer believes that the complication is not infrequently associated with the element of intraperitoneal abscess formation in close proximity to the colon. He examined 250 cases or so of acute suppurative appendicitis in which diarrhea developed in the course of convalescence in 6, and in each of these latter cases the diarrhea was relieved by the drainage of an intraperitoneal abscess.

Therapeutically, the mild cases of diarrhea usually recover as the result of the institution of a restricted diet and the

usual astringent therapy; whereas, on the other hand, any measure that may be invoked will usually prove of no avail in the severe cases, but the possibility of drainage of an abscess in the region of the colon, according to the suggestion of Beer should not be forgotten.

G. PERITONITIS: Peritonitis following gastric operation is of two general varieties: (1) the peritonitis which develops independently of intestinal leakage at the point of the suture-line, (2) peritonitis due to leakage at the point of the suture-line. Whereas from a practical point of view it is highly desirable to differentiate between the two, since operative interference is indicated in the case of the second but never in the case of the first, in most cases this differentiation is very hard to make. A suddenly developing sharp, sticking pain in the epigastrium with symptoms of shock in the course of an otherwise normal recovery points strongly to a rupture at the suture-line. In those cases in which the onset of symptoms is gradual, occurring during the course of the first three or four postoperative days either one or the other variety of peritonitis may be present. In these cases the surgical judgment of the medical attendant is frequently taxed to the limit. The mortality in any case is high. If it is decided that the peritonitis is not dependent upon leakage of the intestinal contents, the ordinary non-surgical treatment of peritonitis, frequently associated with the name of Ochsner, is to be preferred, and consists in the administration of large doses of morphine, assumption of the Fowler position, application of ice bags to the abdomen, the denial of anything whatever by mouth, hypodermoclysis to maintain the fluid intake, and gastric lavage when indicated.

Clinically peritonitis is recognized by (1) increase of temperature, (2) abdominal distension, (3) absence of intestinal peristalsis (silent abdomen), (4) rapidly mounting pulse rate, and (5) subnormal temperature.

Fatal cases rarely develop within thirty-six hours post-operatively and death most frequently ensues about the fourth or fifth postoperative day.

The pulse rate is probably the most valuable indication as to the progress of a case with true peritonitis; a pulse rate of 140 on the third or fourth day indicates a relatively grave prognosis and an increase of 10 beats or more in the pulse rate at this period is an event of particularly evil omen. Probably few patients with a pulse rate of more than 150 at this period survive.

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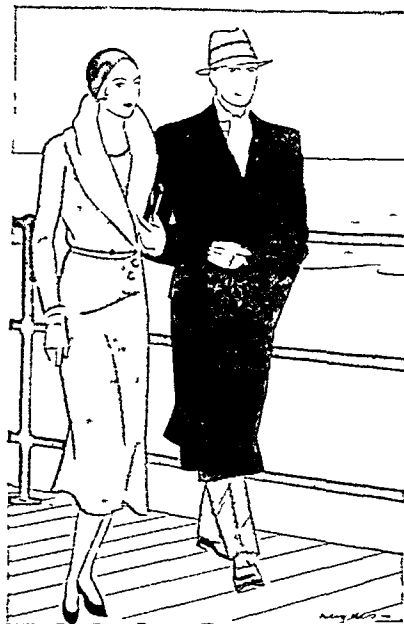
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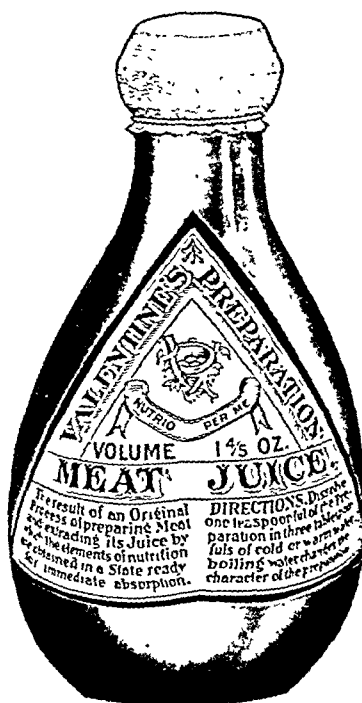
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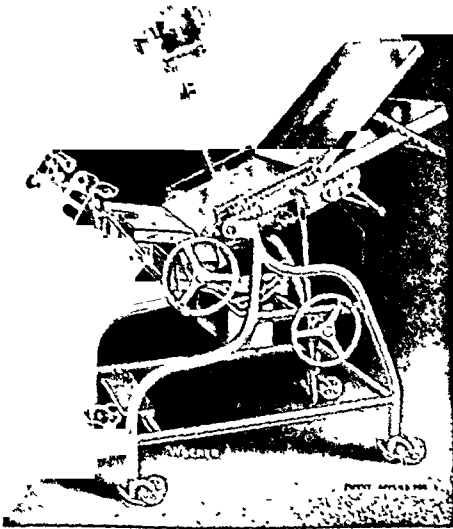
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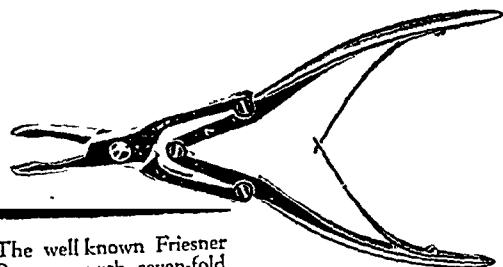
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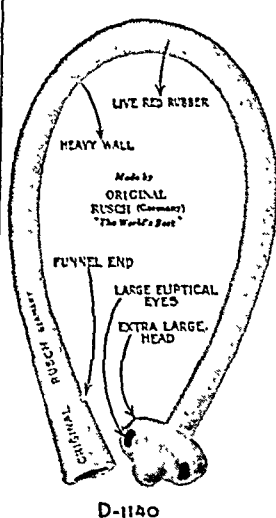
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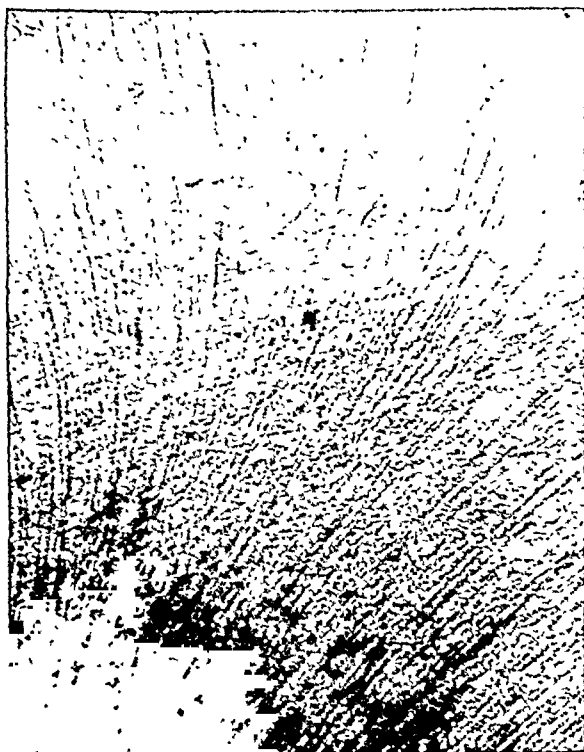
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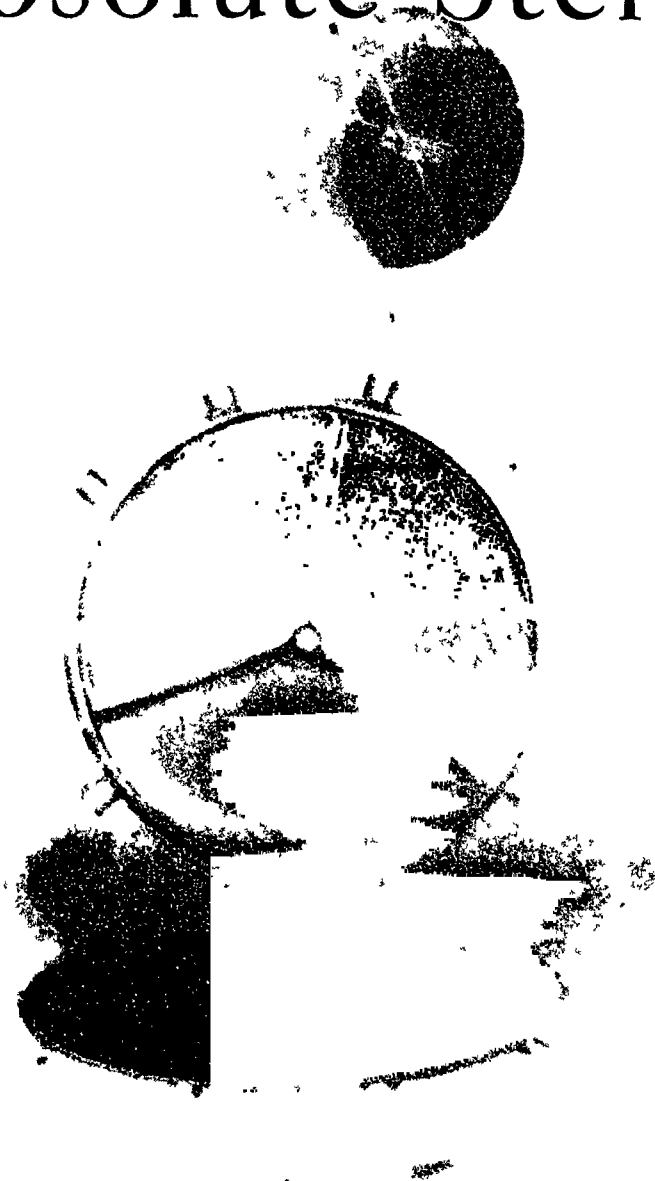
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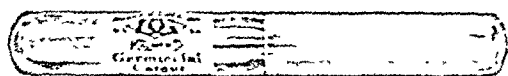
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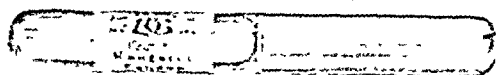
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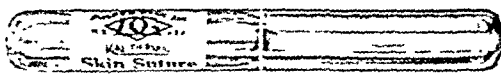
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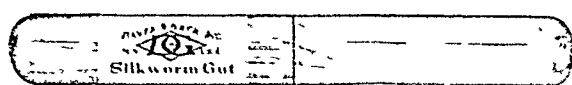
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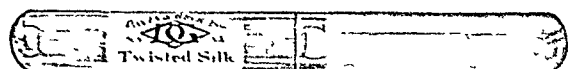


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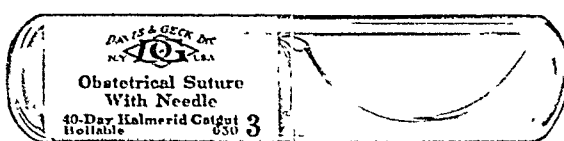
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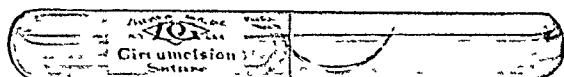
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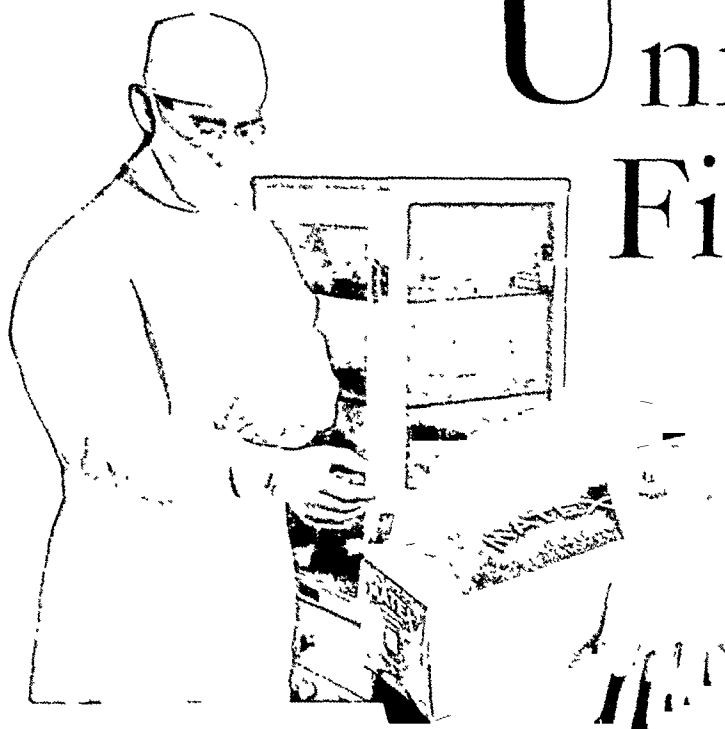
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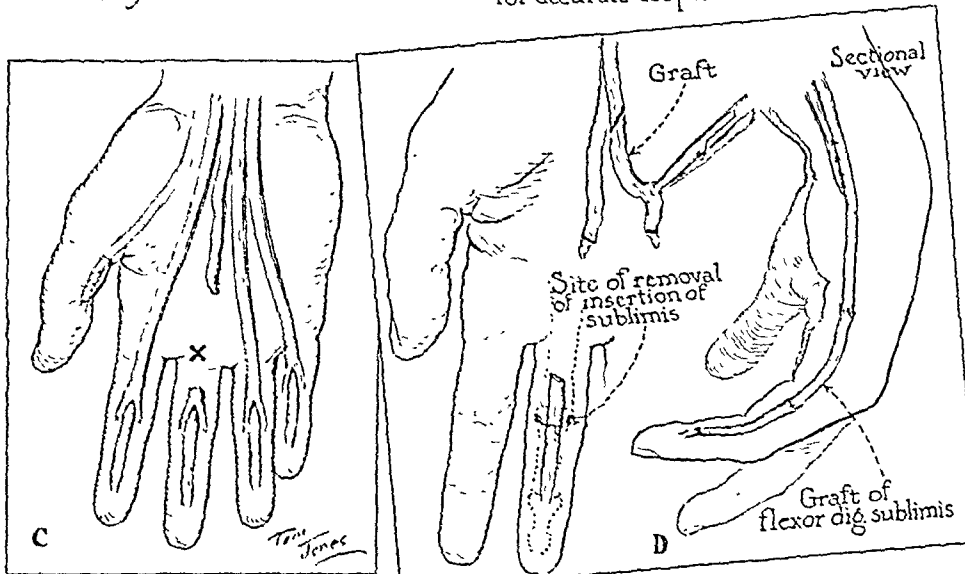
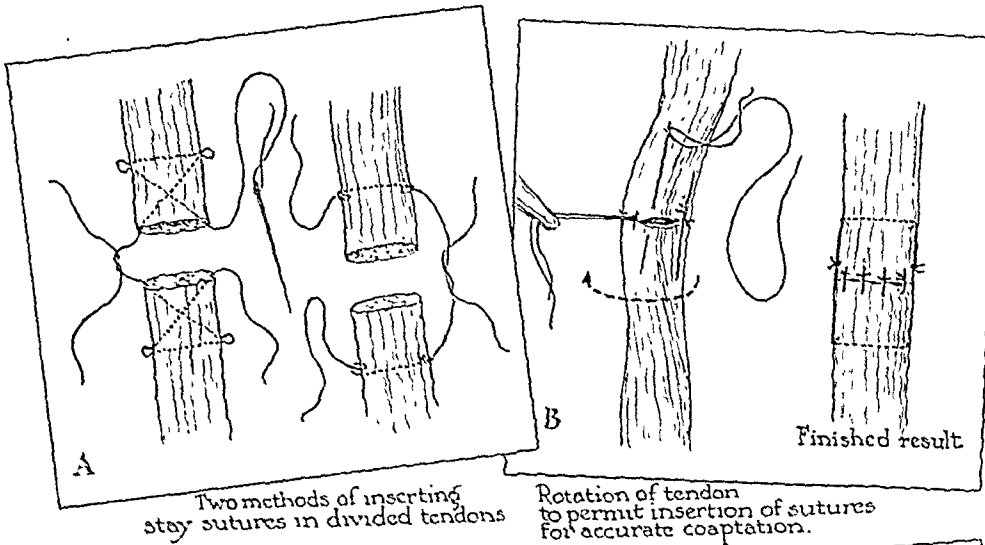
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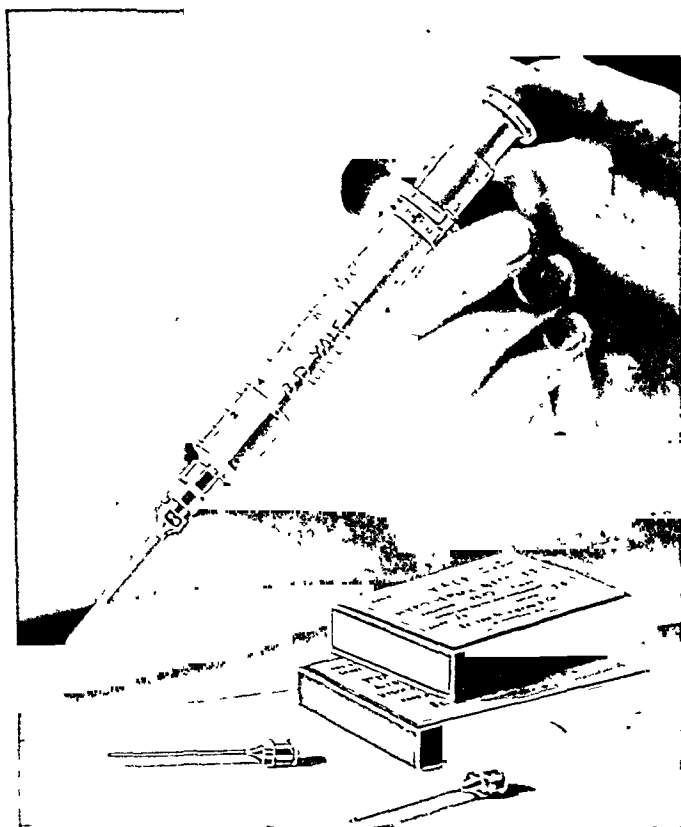
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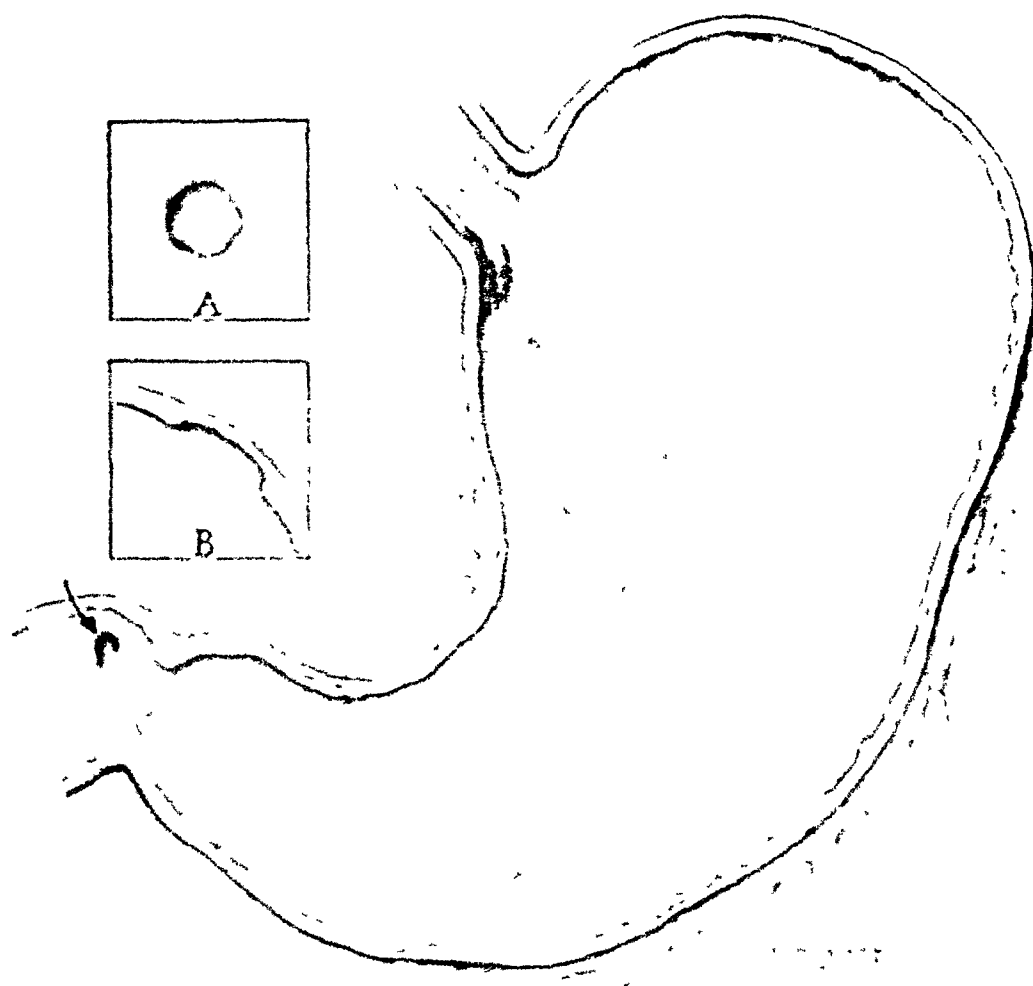
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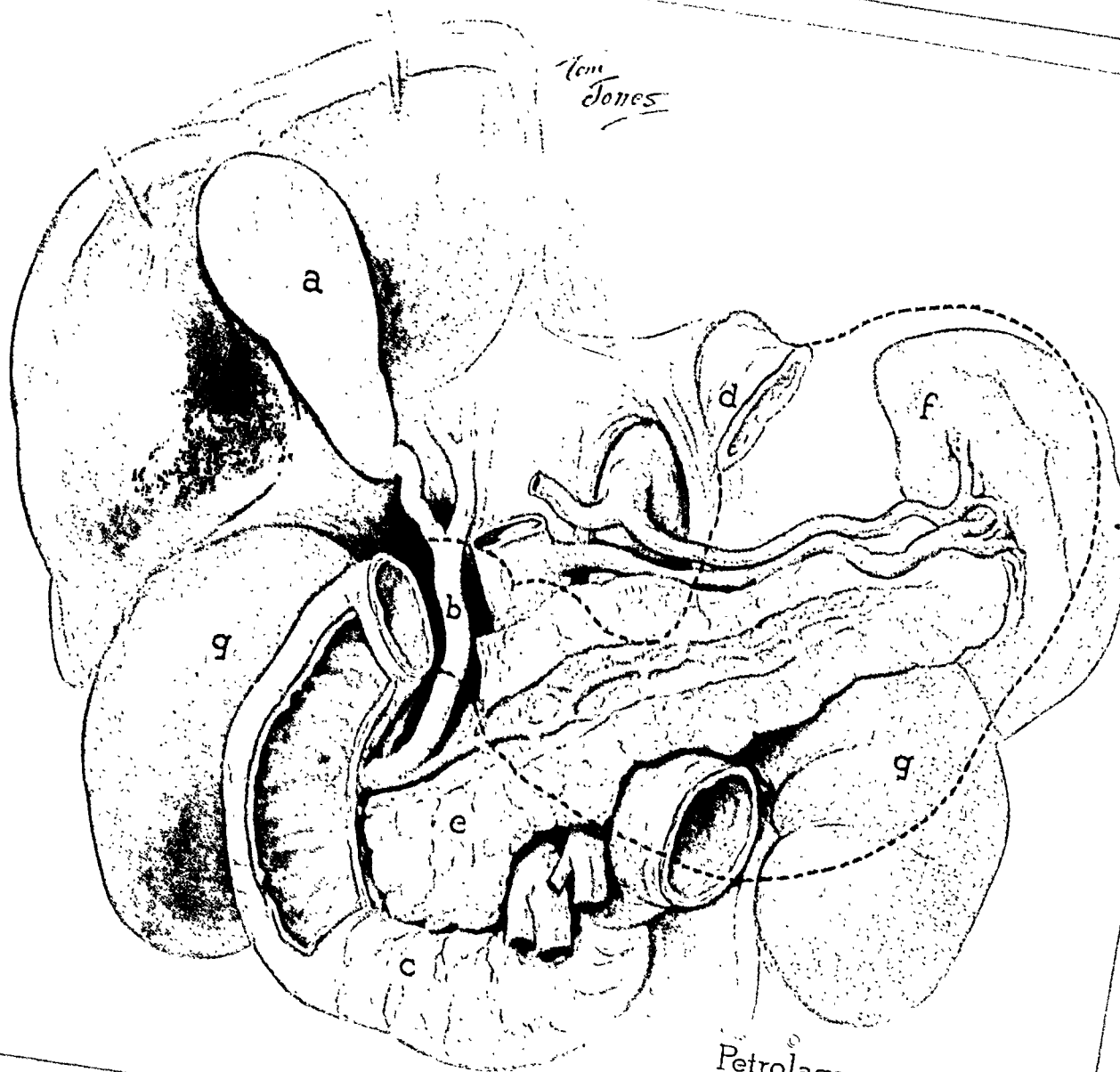
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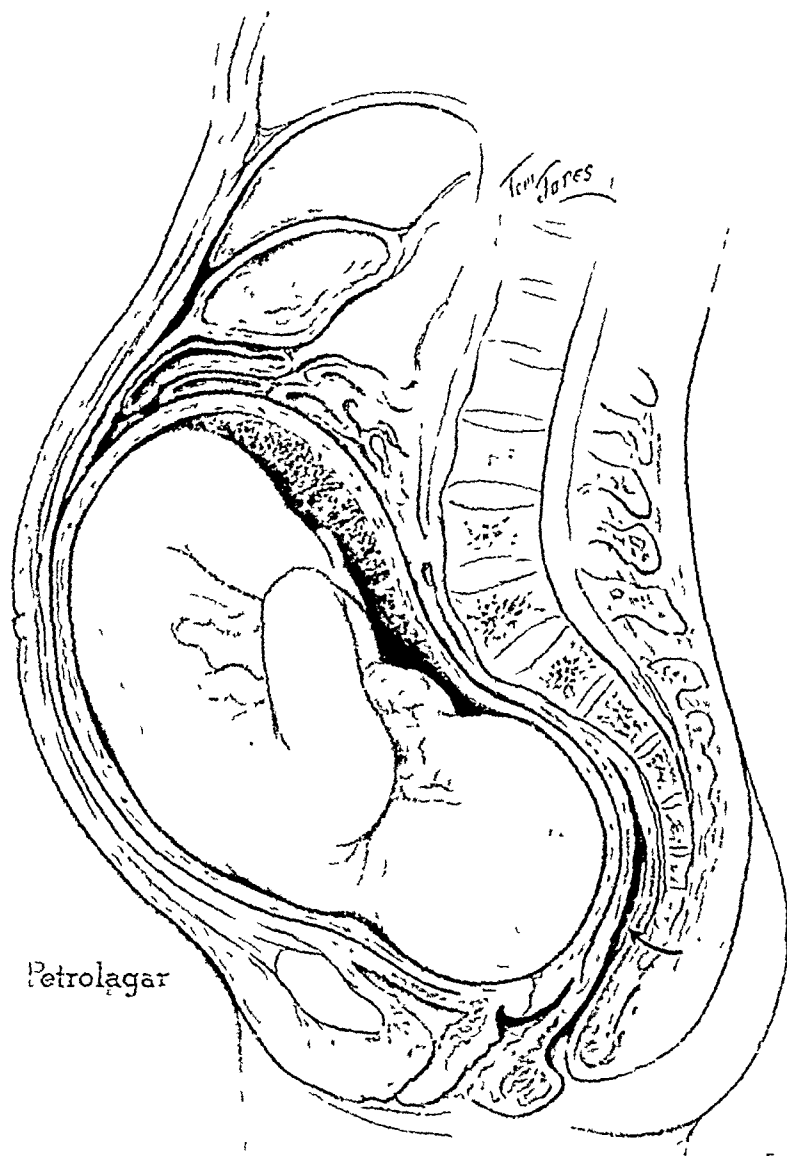
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- a — Gall Bladder
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- c — Duodenum
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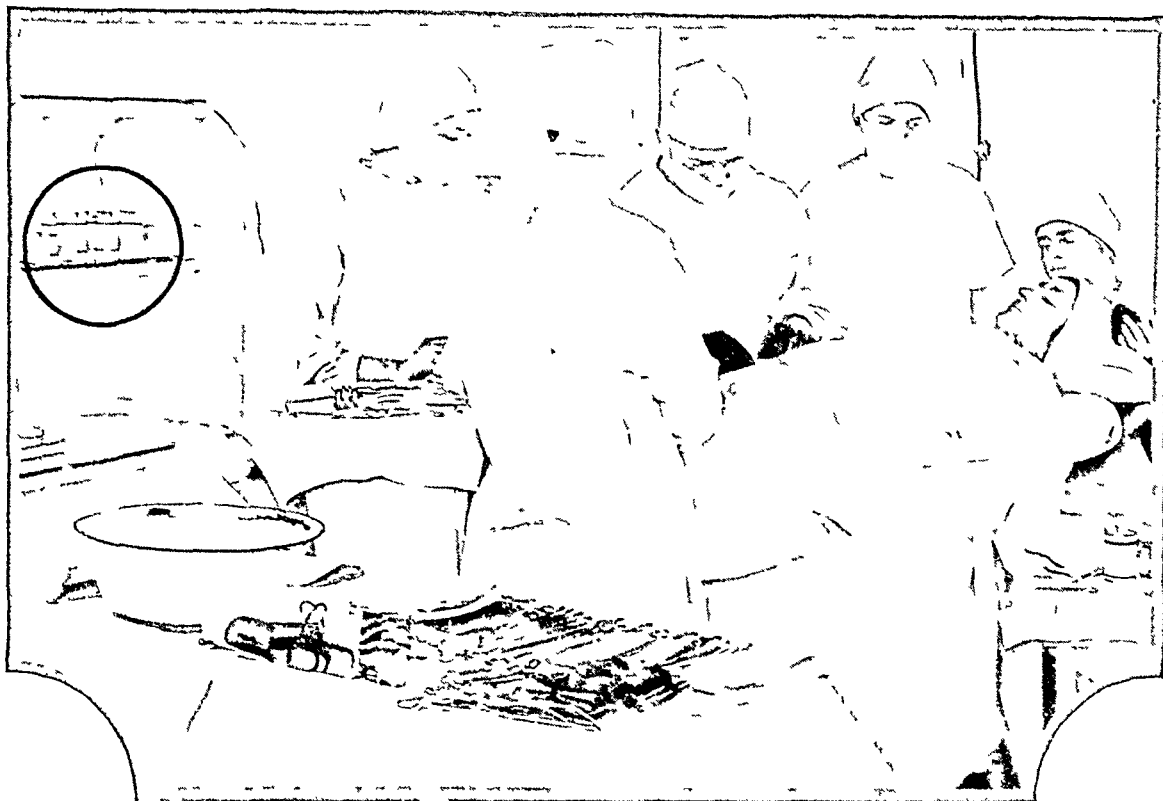
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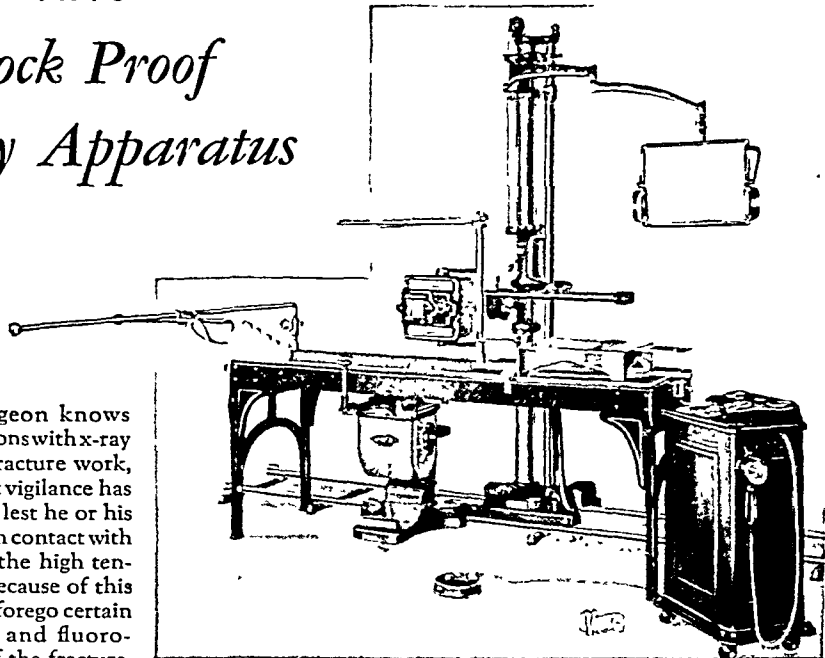
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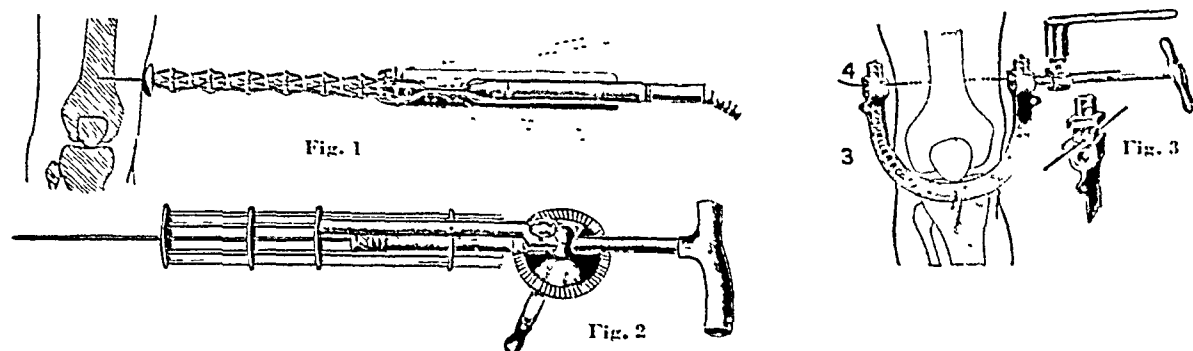
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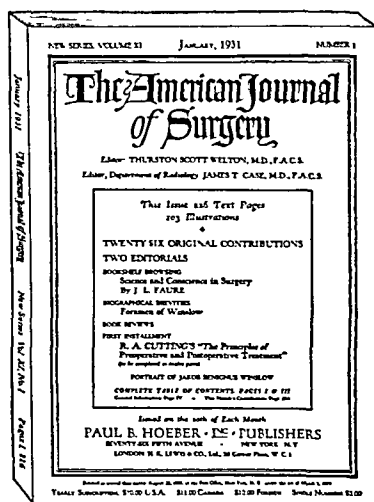
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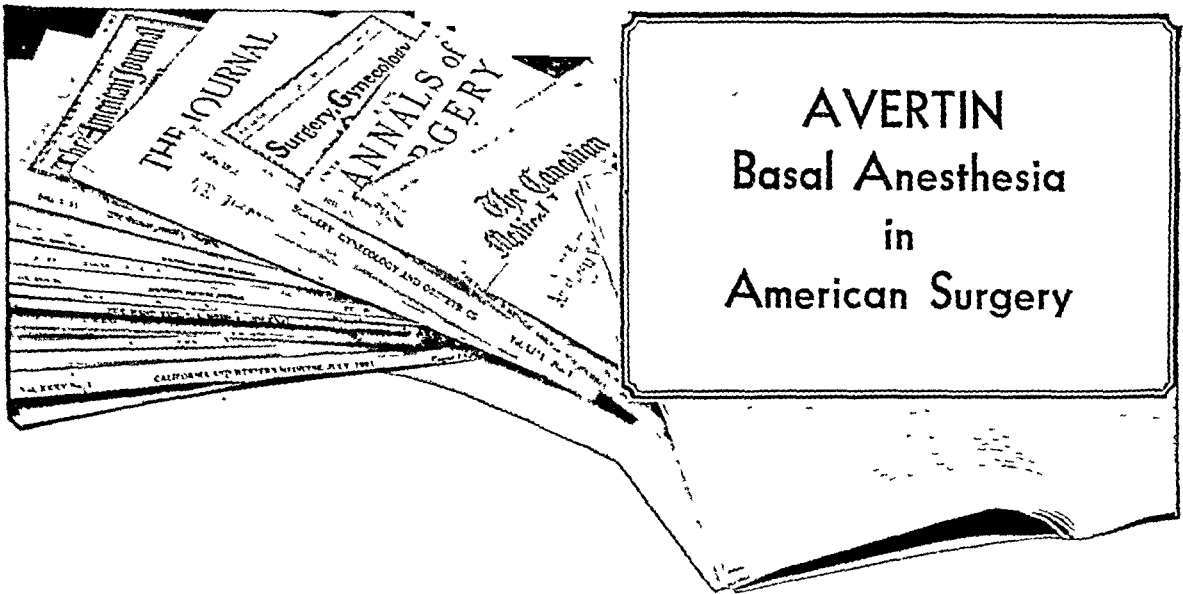
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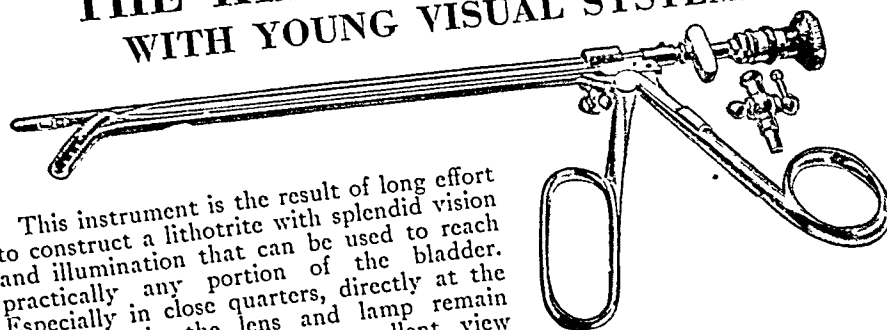
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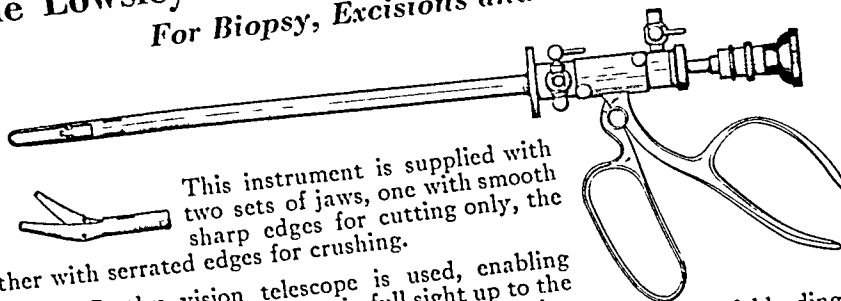
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The large Young telescope is used. It has the adjustable cone fitting to permit its use in a variety of instruments. The handle is easily grasped, and capable of exerting tremendous pressure at the jaws. The jaws have unusual grasping ability, due to the arrangement of teeth which fit into corresponding recesses as the jaws are closed. The jaws are also offset laterally to bring them directly into the center of the field of vision. The hardest concretions can be reduced to fragments without danger of injurious strain on the instrument.

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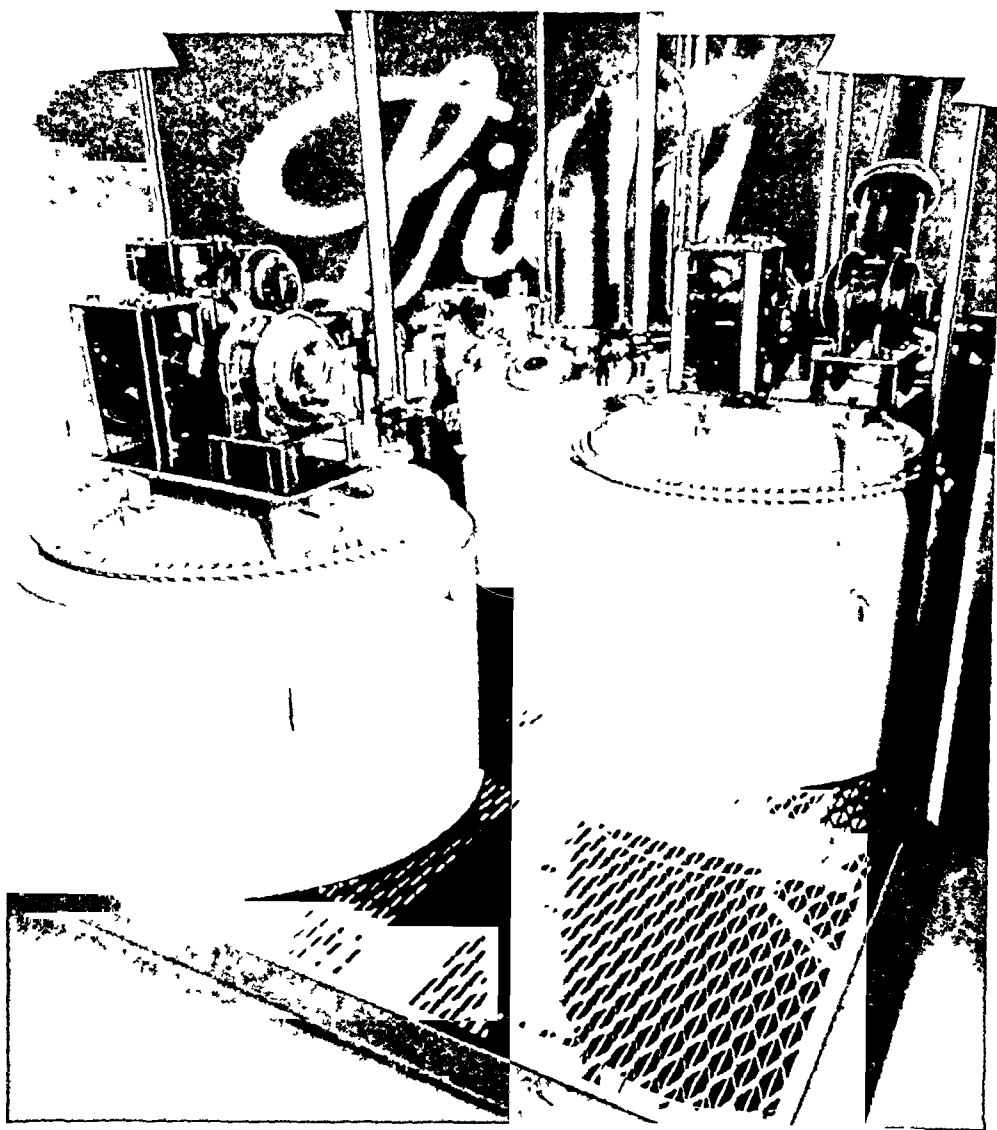
The McCarthy vision telescope is used, enabling all procedures to be carried out in full sight up to the point of closing of the jaws. An adequate irrigating system makes the punch very serviceable even in the presence of bleeding areas in the bladder.

The jaws are large and strong, especially heat-treated for maximum strength consistent with their size and with the force that may be applied at the handle. The two sets of jaws are readily interchangeable. The entire instrument can be easily demounted for cleaning.

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The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIALS

THIS number of THE AMERICAN JOURNAL OF SURGERY is issued in honor of Dr. Rudolph Matas of New Orleans. The entire contents have been written especially for the Matas Birthday Volume. Single copies will be available only with annual subscriptions. The volume will be republished in book form in a limited edition of 1000 copies. The first 400 will be numbered, and signed by Dr. Matas, and will be available through the Committee only. The balance of the edition will be offered for sale by the publishers. The regular departments of THE AMERICAN JOURNAL OF SURGERY: Biographical Brevities, Bookshelf Browsing, Book Reviews and the installments of Cutting's "Principles of Preoperative and Post-operative Treatment" will be resumed beginning with the November issue in which the double column also will be restored.

T. S. W.

This volume is affectionately dedicated to
PROFESSOR RUDOLPH MATAS
our esteemed teacher, colleague
and revered friend

THE PLAN TO PUBLISH A VOLUME OF SURGICAL ESSAYS IN HONOR OF PROFESSOR RUDOLPH MATAS ORIGINATED AMONG A GROUP OF HIS FRIENDS AND FORMER PUPILS. WE TAKE THIS OCCASION TO THANK THE CONTRIBUTORS FOR THEIR CO-OPERATION. WE WISH PARTICULARLY TO THANK THE FRIENDS AND PATIENTS OF DR. MATAS FOR THEIR SUPPORT WHICH HAS MADE THE PUBLICATION OF THIS VOLUME POSSIBLE. WE ALSO WISH TO TAKE THIS OCCASION TO THANK THE PUBLISHER FOR HIS UNFAILING GENEROSITY WHICH HELPED TO MAKE THE PUBLICATION A SUCCESS.

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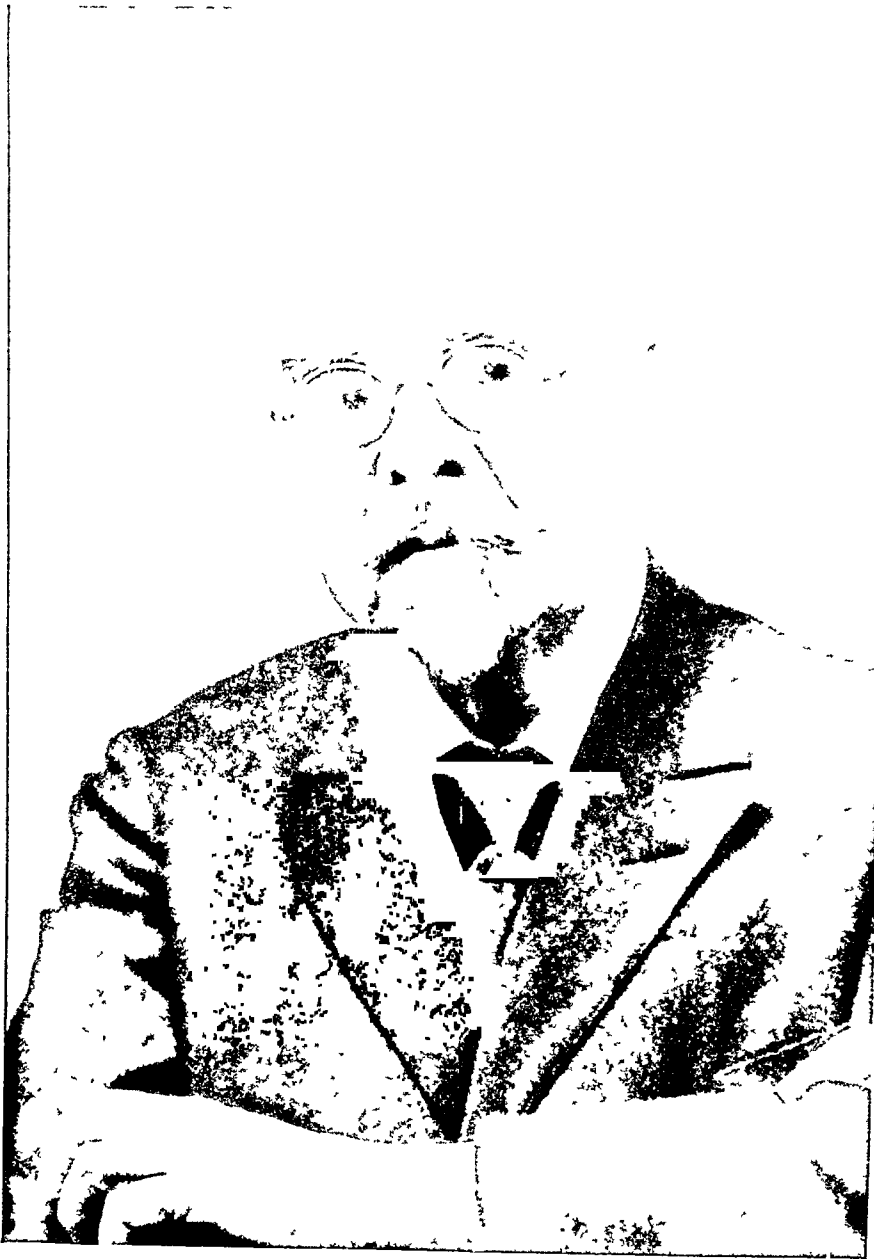
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Rudolph Matas

AN APPRECIATION OF PROFESSOR RUDOLPH MATAS

THIS volume is affectionately dedicated to Dr. Rudolph Matas—our teacher, colleague and friend.

This anniversary which we are celebrating represents the close of five decades of his professional life, as well as the attainment of the Biblical three score and ten. This anniversary is a great epoch in his life as well as in the history of the medical profession of our country.

It is proper that this volume should be dedicated to him who so fittingly represents, by his heredity and accomplishments, the great state in which we live. Louisiana boasts that it has shared the fortunes of four nations—France, Spain, United States of America, the Confederate States, and again proudly our state became a member of the Union. Our beloved friend was born in Louisiana of Catalonian parents just prior to the great Civil War, was educated in Spain and in France, and then he returned to his native Louisiana to grow in strength, and add lustre to our state and nation.

As early as 1879 Dr. Chaille recognized the potential abilities of the young medical student and selected him as secretary of the Commission studying sanitary conditions in Cuba. This association was the beginning of a most beautiful and devoted friendship which lasted during Dr. Chaille's lifetime. It may be said that Dr. Chaille influenced Dr. Matas more profoundly than anyone else. How fortunate this association was can only be guessed.

When one thinks of Dr. Chaille (the methodic precision with which his daily routine was followed, his remarkable analytic mind, and the fearlessness with which he expressed his convictions) it is easy to see how his influence was so remarkable as a guiding factor in the life of his younger colleague, Rudolph Matas.

Soon after graduation, Dr. Matas became identified with the Department of Anatomy of Tulane University. His untiring efforts and his brilliant accomplishments made him the logical successor to Dr. A. B. Miles whose untimely death created a vacancy in the Department of Surgery. The selection of a successor for Dr. Miles created much discussion and controversy because the faculty sought an outsider. Dr. Andrew W. Smyth in 1893 said:

It is nothing short of an outrage that the faculty of Tulane university should entertain the idea of going to Baltimore to fill the chair recently made vacant by the death of Dr. Miles. Dr. Matas has genuine ability, which, in my judgment, is superior in many respects to genius itself. He is beyond question the greatest surgeon New Orleans has ever possessed. There is nothing that he teaches that he does not exhaust. I feel certain that the future will certainly corroborate the opinion which I now express regarding Dr. Matas, and any honor bestowed upon him will be justified by history. I am in earnest when I say that Matas is a greater surgeon than Stone, Miles or Smythe have ever been, and he is profiting by experience, reading and writing all the time. Whatever position, reputation or standing he has thus far acquired in the profession, is the result of his own intrinsic merit and the application born of intelligence and superior judgment. Besides his knowledge of his profession, he has versatility as well, being scholarly, and a clear and fluent writer, on any subject. [Smythe.]

According to Miss Jane Grey Rogers: "Teachers, students, citizens all united in one grand chorus of support, and again harmonized into one tremendous Amen when the final decision of the faculty became public property."

It is a source of great regret that this note of appreciation could not have been written by Miss Rogers whose intimate contact with Dr. Matas for many years made her his natural biographer. In token of this desire, to make her take part in this anniversary testimonial of esteem, it is fitting that we take something from her writings.

In an editorial in the *New Orleans Medical and Surgical Journal*, December 1924, Miss Rogers, discussing the election of Dr. Matas to the Professorship of Surgery, said:

So it came about that the youthful acolyte passed from his novitiate into the full heritage of knighthood and received the chair of surgery as a token of his unblemished chivalry and unswerving devotion to the vision of High Calling. There may he long remain the great high priest of surgical principles and medical ethics, in whose consecrated hands the scalpel remains an untarnished excalibur, potent in the exercise of good, and equally powerful in the destruction of evil.

In this memorable editorial of hers, Miss Rogers said: "Were it permitted 'The Soul of the Surgeon' to assume fleshly form, there are not a few among us who strongly suspect that the incarnation would wear the familiar features and walk the accustomed ways of that 'good physician,' Rudolph Matas, with whose inspiring presence it has pleased God to bless our generation."

Let these expressions symbolize a bond in immortality of this gentle lady, who has passed on, with our Chief "whose glorious name, even while he still lives, flashes in the constellation of immortality." (Jane Grey Rogers.)

The pean of praise, begun by Dr. Andrew W. Smyth and his contemporaries, has continued through the years gaining in volume and in harmony until today great symphonies have been written by Cushing, Porter, Frederick L. Hoffman and others who have been privileged to meet him on occasions. Those who know Matas best and love him most are anxious that these evidences of appreciation should be more generally known, therefore, the tribute paid by Cushing at the time of the presentation of the Bigelow Medal is liberally abstracted:

Rudolph Matas: Through the generosity of a man, whose recent death we greatly lament, it has been made possible for the Boston Surgical Society to confer from time to time, at their discretion, a medal in memory of his distinguished father, a medal upon those who likewise have attained particular eminence as surgeons . . .

This society has already bestowed the award upon a surgeon of the Middle West, the originator and main-spring of a famous clinic; then upon another, justly regarded as the doyen of American Surgery, a man of imperishable youth, whose sesquicentennial, it is rumored, is being held in his native Quaker city. It now has again unhesitatingly, unanimously,

and fittingly voted the award to you who represent still another section of our vast country . . .

The surgery of the South flows by your door as do the Waters of De Soto's mighty river by the levees of the romantic city which claims you. But you, sir, on your record, would have been our choice, residing in any land. Chance only has placed us in a common nation. The Louisiana purchase; the migration to Bonnet Carre of a Spanish physician, your father; the preservation of the Union. These three happenings conspired to make you a great leader in American surgery, instead of the great leader that you otherwise might have been in the surgery of your father's native Spain where you had your boyhood education; or in what might have been the Southern Confederacy, or indeed in what might have remained Colonial France.

In your professional life you have exemplified what Guy de Chauliac said the surgeon should be; "Bold when sure, Cautious in danger; Kind to the sick, Considerate of your fellow workers; Uninfluenced by gain . . . But you have been more than this. You have been a faithful and inspiring teacher in your Alma Mater to a host of students this past forty-six years. You have made notable additions to knowledge. Yet your generosity has led you habitually to magnify the importance of work done by others; your native modesty to minimize the importance of your own. Your contributions have been characterized not only by a Castillian brilliance of conception, but by a Gallic gift in exposition which we inarticulate people largely of Puritan ancestry can but envy and admire.

At this time Dr. Porter paid Dr. Matas the following tribute: "His genius, like a bright jewel with many facets, has illuminated many of the dark places in surgery. To know him is to realize the heights of his idealism and to fall at once under the spell of his lovable personality."

Dr. Frederick L. Hoffman, one of the world's greatest statisticians and a loyal friend of Dr. Matas, expressed his appreciation in the following poem:

Son of the Latin Southland
Son of a sunkissed soil,
Born to the purple but man of choice
To a life of arduous toil.
Known to all as a surgeon
Master of exquisite skill,
Saving the lives of the dying,
Comforting, aiding the ill.

Friend to all who are struggling,
 Kind to the lowly and poor,
 Generous host to those who pass
 Through his always open door;
 Versed in all arts and in science,
 Gifted with grace and with tact,
 In peace and in war in the forefront
 Never afraid to act.

Teacher of countless students,
 Medicine's proudest boast,
 Leader in every movement
 In matters that count the most.
 Beloved by all who know him,
 Rich or of slender means,
 The pride and joy of the city
 Of beautiful New Orleans.

May he live long and be happy
 Wearing the laurel he's won
 Sorrow will fall on the city
 When in time his labors are done.
 But enshrined in the hearts of the people
 Will be the name of the surgeon who was,
 Live on forever and ever,
 The deathless fame of Matas.

We marvel at the developments of surgery since Pasteur and Lister yet we only know it from history and tradition. The great leader whom we honor at this time had grown into manhood before the principles of Lister had been generally accepted, in fact, one of his intimate friends and contemporaries, the late Dr. Frederick W. Parham, that mild mannered, simple, honest, noble gentleman, was the first to introduce sterilization by steam into Charity Hospital at New Orleans.

Rebellion was in the air soon after the birth of Dr. Matas; rebellion not only within the Union, but in medicine. This rebellion was soon to break out. Empiricism was to be set aside and science to replace it. No single soldier in the army of progress has fought more valiantly than Matas to set aside

tradition for scientific principles. Early in his career he substituted the scalpel for the amputating knife, the Gigli saw for the old butcher saw, the tourniquet and Esmarch bandage were utilized by him in an effort to obtain an almost bloodless field. No effort was too great for him to use to prevent loss of blood. Fine anatomic dissections replaced the sleight-of-hand performance of the older surgeons. The introduction of local anesthesia, in which he was a pioneer, enabled him to reduce the painful effects of mutilating operations. Finally his triumphant efforts in the field of vascular surgery crowned him with glory and made him properly one of the generals in the victorious army of the rebellion.

No one has ever been better fitted by natural physical powers to stand the great struggle than he. One of his proudest possessions, according to his own statements, is his inheritance of a strong constitution. On the occasion of the presentation of a token by his New Orleans friends, after he had received the Bigelow Medal, Dr. Matas said:

To my parents, I owe a clean and robust inheritance, an honesty of purpose, a sense of duty and perhaps, from my father, who was also a Doctor of Medicine, the congenital inclinations and the elementary foundation for a medical career. For these, I owe them a debt far more precious than all the fortunes and all the titles that they could have bequeathed me.

In his greatness he is still humble. When a great honor was conferred upon him he shared with his teachers, pupils, and the profession generally his success. The following abstract evidences the truth of this statement:

To my profession, to Medicine, I owe everything that has helped to make me useful and thoroughly contented with my lot . . .

I fancy that I can see the shades of my venerated teachers Chaille, Richardson, Bemiss, Logan, Elliott, Sr., Joseph Jones, Souchon and Miles, the stalwart group who composed the Faculty of my student days; they who ushered me into the medical world—now all vanished from this earthly sphere, but living still by their example and their teachings, and by their indelible impress on the Roll of Honor of medical Louisiana . . .

And now the vision changes and I see another picture. I see marshalled a great army passing in review before me. It is the army of the Alumni of the medical school who have been graduated in Medicine during the years of my incumbency. This is the host of health and healing, nearly 3,500 strong, taught, and drilled in the training camp of Tulane; intelligent, educated men, flaming with youth and ambition, to carry the seed of knowledge and service to all quarters of the continent and far beyond the seas, under the banner of Tulane. To all these, who in the procession of the years, have sat in successive classes on the benches before me, and to the many who have served me loyally and diligently as interns, in my service at the Charity and Touro I owe an immeasurable debt. Not only for their material collaboration in accomplishing the tasks in which I have been engaged, but to the whole student body for the inspiration, the stimulus, the compelling influence that their enthusiasm and inquisitive youth have had upon me in sharpening the edge of my own intelligence, that I might be fit to guide them, in the ever-changing, ever-advancing knowledge of the craft, and to give firmness to my hand that I might hold the torch of Hippocratic tradition and conduct steadily before them.

In an effort to express a word picture of our great and distinguished teacher we must turn back the pages of history to find de Chauviac's statements of the "Qualifications of a Surgeon":

Let the surgeon be well educated, skilful, ready and courteous. Let him be bold in those things that are safe, fearful in those that are dangerous; avoiding all evil methods and practices. Let him be tender with the sick, honourable to men of his profession, wise in his predictions, chaste, sober, pitiful, merciful; not covetous or extortionate; but rather let him take his wages in moderation, according to his work, and the wealth of his patient, and the issue of the disease, and his own worth.

Let us for a moment pause and let our own beloved teacher give his own conception of the qualities which the surgical mind should possess:

The surgical mind manifests a special fitness to serve the functions of surgery in the artistry with which the Surgeon applies the scientific principles of his craft, in the clarity of his vision, and the breadth of his concepts, in the wisdom of his judgment, in his initiative, in his daring and resourcefulness; in the courage of his enterprises, in his high sense of duty, and his sensitiveness to his professional responsibilities; in his sleepless vigilance

for the safety of his patients, and in the adjustment of his physical qualities to his mental processes . . .

Salient among the qualities of the surgical mind is that highly prized faculty that is known as surgical judgment.

These qualifications which Dr. Matas has outlined in words have been indelibly impressed on his associates by his deeds. The intangible expressions which he uses, *Soul of the Surgeon*, *Surgical Mind*, and *Surgical Conscience* are given visible human form and have been electrified into action by his own consecration to the idealisms which he practices.

It is almost a hopeless task to convey an idea of his education because his fund of information is so much greater than that of his associates that we can only guess its limitations. We only know that no one of his associates has ever been able to find a subject whether it be medicine, in any of its branches, art, music or the sciences, about which he is uninformed.

Many stories could be introduced to illustrate this point. A few will serve the occasion.

A distinguished internist was once asked whom he considered the one Doctor who alone could be depended upon for diagnosis and suggestions for treatment of medical cases. This internist unhesitatingly said—Dr. Matas.

Many great American surgeons have unequivocally stated that Dr. Matas is the best informed surgeon in America. One of his former interns on an occasion thought he had found something which the Chief had not read. Having read the article in a Canadian medical journal this intern asked Dr. Matas, the following day, what he thought of the problems discussed in this article, to which Dr. Matas replied, "recently a very interesting article appeared in a proprietary Canadian journal covering many valuable points about the problem you are interested in." At once the intern realized that even the proprietary journals had not escaped Dr. Matas's uncanny ability.

Lafcadio Hearn, who was a great friend of Dr. Matas, paid tribute to his versatility in a letter to Dr. George M. Gould of Philadelphia. He wrote:

My friend is very young, but already somewhat eminent for some years at our University, and will ultimately, I am sure, turn out a great name in American medicine. But he is a Spaniard, Rudolfo Matas . . .

I first felt really quite curious about him after having visited him to obtain some material for a fantastic anatomical dream-sketch and asked where I could find good information regarding the lives and legends of the great Arabian physicians. When he ran off a long string of names, giving the specialties of each man, and criticising his work, I was considerably surprised; and even felt a little skeptical, until I got hold of Leclerc and Sprengel and found the facts there as given me by word of mouth.

This versatility includes a linguistic range that made him a marvel to his interns. As he would go from bed to bed in our great institutions in New Orleans, he would address his patients in French, Spanish and in Italian. The most lowly were made to feel just as much at home with him as the most highly educated. Each patient was made to feel grateful because of the ministrations of our distinguished friend, whether those ministrations were to the physical or mental needs of the patient.

His mind is remarkably receptive and retentive. The quality of visualizing his knowledge of anatomy for utilization in surgery has inspired his associates, and has enabled him to extricate himself and his patients from difficulties that would have been unsurmountable by one less well informed.

Dr. Matas may be truly called an artist in surgery as contradistinguished from the artisan. The artisan or operator executes manual acts often dictated by his medical confrere. Dr. Matas, the artist, has made the execution of his work symbolic of his appreciation of the tasks which have confronted him. His efforts have evidenced his love of the opportunity of relieving the suffering and of directing others in paths that would bring aid to untold thousands who will be totally unconscious of the guiding influence in their recovery.

By recording his impressions of the tremendous amount of clinical material which he has seen and correlating these with a knowledge of the literature, he has added to the storehouse of human knowledge. This combination of knowledge and observation has made his diagnostic acumen the wonder of his

associates. His indefatigable energy can best be understood if interpreted in the words of the late Arpad G. Gerster: "Love of one's chosen work has the magnetic power of turning Adam's curse into a blessing."

His work as a surgeon has been revealed in his writings. Particularly do we find a mirror of his life and work in his appreciation of Halsted. Dr. Matas has constantly inveighed against "Prize Ring" tactics when applied to the operating room. He has rather practiced and pleaded for the conscientious application of knowledge for the saving of life and limb.

It is futile to try to describe his attitude when he has given it to us in such a clear way in his appreciation of Halsted. He does not reckon as brilliant

. . . the surgeon who utilizes his opportunities to dazzle the public with the prodigies of his skill, who listens for the plaudits of the multitude more intently than he does to the murmured approval of his conscience and who burns his incense to the gods of the gallery. I do not reckon speed as brilliancy when displayed chiefly, if not solely, for spectacular effect; when it is exhibited at the expense of security and when appraised as skill it is rated above caution and judgment at the hazard of the patient's highest interests. According to my understanding brilliancy in surgery lies more in the results of the surgeon's intervention than in the immediate act. To my mind he is the most brilliant surgeon, who, in equality of circumstances, saves or prolongs the greatest number of lives and who restores his patients to health in the shortest number of days. [This is the] sort of brilliancy for which every conscientious surgeon who places his patient's welfare and the good repute of his profession above the vanity of his own flesh, should strive. Admirable and necessary as is the cunning of the hand, its obedience to command is not all. Something more is required. The surgeon needs to cultivate the subtle touch, the sentient finger and obedient hand. He needs the broad vision that is his only through the light of science, the cultivated imagination, the catholicity of artistic taste and human sentiment, that give to his manual accomplishments the attributes and qualities that glorify the hand in the higher arts. To do all this, and to be all this, the master surgeon must be a man of mind, a man of thought, and a man who knows his province—the human body—as a whole and not only in one of its parts.

The human body is the only model that the surgeon can follow if he is to apply his craft with certainty and safety. Anatomy in its applications to surgery is as necessary to the surgeon as a chart to the navigator, and

the surgeon can no more be trusted to find his way in a tangle of vital organs, blood vessels, muscles and nerves, which make up the flesh, and conduct his operations to a successful issue, than a pilot could be trusted to guide a great ship, loaded with human freight, to a safe berth in a dangerous harbor, without an intimate knowledge of its tortuous channels and its treacherous shoals.

Today when we find attempts being made to shorten the training of the medical student in anatomy there is reason for reflection lest we find the future surgeon less well prepared than his predecessor.

Dr. Matas, even though success has crowned his efforts, has never allowed the bright lights to dim his vision. Each success has simply spurred him on to renewed efforts so that he might continue to record his impressions and rise to greater heights. Like all great torch bearers of knowledge he has linked by his efforts the past with the present that the future may be more glorious because of his having lived.

His life has been the embodiment of the principles enunciated by Tennyson in his *Flower in the Crannied Wall*:

Flower in the crannied wall
I pluck you out of the crannies;
Hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.

Emerson said that "Character is higher than intellect." The consecration of our friend to the cause of humanity, his fight on charlatanism, fee splitting and all such degrading practices mark him as one who has fought to keep the banner of surgery on the heights. From the "Soul of the Surgeon" I quote:

Charlatanism, like all other forms of parasitism, has always existed. The outward forms of the parasite—his morphology—have changed with different ages, climes, and people, and, in this, it has simply followed the laws of adaptation to environment that characterize all other forms of parasitic life. The externals change, but the biologic instincts, the symbiotic habits, and the vampirism of the parasite remain the same . . .

Let us not, then, confuse the parasite with the host. Let us not mistake the false from the genuine. The imposter in surgery is a soulless individual and, as such he has no place in a discussion on the Soul of the Surgeon - except to repudiate him as counterfeit or false coin.

Again Dr. Matas says with reference to this group:

Unfortunately, Surgery, as all other professions, the law, and the ministry, has its due proportion of moral defectives, who, are born conscienceless, who may be intelligent, but soulless; who gain entrance into the fold, as wolves disguised in lamb's clothes. These are men who only dream of their sordid ambitions, either for lucre or to satisfy their craving for notoriety as great operators, and whose sleep is never disturbed by reproachful visions of funeral processions; whose failures only worry them because of the effect they may have upon their reputation, their bank account, or their statistics. These men, not unlike the egotistic conquerors of History, are moral monstrosities, fit only to be exhibited in pathological museums. They have no place in the hierarchy of Surgery and are only mentioned to be condemned and repudiated as the nauseous excreta of a healthy body.

Can any one who has been a pupil of Dr. Matas fail to have learned that the life entrusted to him is a sacred trust, that his responsibility is greater than can be estimated? Can he fail to appreciate that the life entrusted to him is something that cannot be recreated by the hand of man, and that through ignorance or neglect an irreparable damage may be done?

In the wards of his beloved institutions, Charity Hospital and Touro Infirmary, some of you well remember the opportunity that was yours of watching with him by the bedside for hours at night. Can you ever forget the rapidly fired series of orders for first one thing and then another as aids for the suffering and apparently dying individual? Can you ever forget the inspiration and instructions? Can you ever forget that it was under such conditions as these that many of us learned to appreciate the responsibilities which the surgeon shoulders? Of this responsibility Dr. Matas has spoken and from his work I quote the following:

It is he, the commander-in-chief, he, alone, who is responsible for the safe guarding of the life that is entrusted to his care. All the others like the officers and crew of a ship are merely responsible to him, as the Captain, for the faithful execution of his orders. The Surgeon may rest his trust and confidence in the expertness and efficiency of his collaborators and

subordinates, but the chief responsibility must always rest with him, and being his, must be exercised with authority, not only during the operation, but also before, perhaps long before and also after, perhaps long after, the operation has been performed . . .

If it has its tragic hours, its hours of bitterness and sorrow, it has also its superb and glorious hours, and the greatest joys. For what joy can be sweeter, or can compare with that of conquering disease, to triumph over Nature, and to be "even stronger than Death."

Appreciation of responsibilities has constantly characterized his life and his work and his devotion to duty has inspired us to emulate his example. Others may draw inspiration from the nobility of his words and deeds. If we be true to him we cannot fail to realize that the opportunity which was ours was the greatest privilege of our lives.

Dr. Matas has constantly maintained that clinical experience is of supreme importance for the development of sympathy, tenderness and charity for he says:

In the clinic you are brought face to face with a conscious human, whereas in the laboratory, the student has learned with the microscope how to distinguish between different strains of virulent and specific micro-organisms,—the staphylo—and streptococci, the colon bacillus, the tubercle bacillus, the gonococcus, the treponema of syphilis and other innumerable germs and specific tissue cells, such as the cancer cell,—but when he comes to the clinic or the ward, he will be lost and utterly incompetent to recognize or distinguish between the diseases caused by these germs, when he sees them at the bedside, though they may be clearly and unmistakably stamped upon the countenance or the body of the patients. It is in his ability to read the physiognomy of disease, to classify diseases, to recognize and identify morbid processes in their multiple disguises and protean phases; and, again, in appraising their effects on the human organism, as these are modified by the physical and psychical reactions that are peculiar to each and every individual,—that of the art of the Clinician, whether Physician or Surgeon, differs radically from the expert in the laboratory.

Of the *Tactus Eruditus*, about which he has written so much—no one has ever possessed, we believe, this power to a higher degree—he says:

The cultivation of the sense of touch has always been recognized as one of the characteristics of the surgeon.

The educated sense of touch of the experienced surgeon asserts its supremacy as a guide to the hand and to the mind, in its most difficult diagnostic and operative enterprises. Infinitely more valuable to the Sur-

geon, when in action, than the x-rays, since it allows the surgeon to discriminate between the normal and the abnormal and to operate in the deepest, darkest, and most dangerous cavities of the body, with a certainty and security that the most penetrating Roentgen light will fail to illuminate.

He has been truly a sunbeam in the dungeon to the patient and the family wrapped in the darkness of despair. If one may judge from the many expressions that have come from grateful patients he has gained through his efforts for them that spark of eternity or immortality which the human mind is capable of—gratitude, a gratitude which like the ripple produced by a pebble will increase as men gain a better knowledge of this great soul.

He is a true example of the individual who can still record impressions by continual work after he has been acclaimed by the whole world. If no other opportunity was ours as students of Tulane University than the inheritance that he was the great leader and inspiring teacher for more than thirty years, the privilege would be great. This teacher I am grateful to say lives for us to gaze upon. He stands as an embodiment of the truths of the profession which have been handed down to us through the ages.

When the influence of many of us will be scattered as grains of sand by the wind, Dr. Matas's influence will be as a beacon light across the storm-tossed sea in the life of many men. The rays of this light will continue to carry the message of devotion to duty, love of mankind, mercy to the needy and sick, and humility.

We marvel at him because he is possessed with Hippocratic powers of observation, the boldness of McDowell, the courage of Pasteur, the anatomic knowledge of Hunter and Da Vinci, and the cultural development of Weir Mitchell.

We say that he is a citizen of New Orleans. He is a rare mixture of the Old World and the New. He is a citizen of the World. He is a towering figure in the world of medicine and of men. He has proved himself to be a chivalrous knight and at once an humble worker, a literateur, a dreamer, an original thinker and a thorough master of the art of surgery. His ways are modest, his motives pure.

RUDOLPH MATAS*

Born in Bonnet Carre, near New Orleans, La. September 12, 1860. Son of Dr. N. H. Matas and Teresa Jorda, both natives of Province of Gerona, Spain.

Primary education: Barcelona, Spain; Paris, France; Brownsville, Texas; Soule's College, New Orleans; graduate of Literary Institute of St. John, Matamoros, Mexico, 1876; M.D. Tulane University, 1880; LL.D. (Hon.) Washington University, St. Louis, 1915; sc.D. (Hon.) University of Pennsylvania, 1925; LL.D. (Hon.) University of Alabama, 1926; sc.D. (Hon.) Princeton, 1928; LL.D. (Hon.) Tulane University, 1928; F.R.C.S. Eng. (Hon.) 1927; F.A.C.S. (Vice President 1913-1920, President 1924-1925).

Widower. Established in New Orleans since graduation. Specialist in surgery since 1895; Professor of Surgery, Medical Department, Tulane University, 1895-1927 (Emeritus since 1928); Chief Senior Surgeon, Touro Infirmary, 1905- ; Charity Hospital Visiting Staff, 1880-1928 (Senior Surgeon, 1894-1928); Consulting Surgeon, 1928- ; Eye, Ear, Nose and Throat Hospital Consulting Surgeon, 1885- ; etc.

Major and Director, New Orleans School for Intensive Surgical War Training; Medical Officer, Reserve Corps. U.S.A., 1917-1918; Member, Louisiana Council National Defense, 1915-1918; Organizer and Director, Base Hospital No. 24 (Tulane Unit) for service in France, 1916-17; Member, Orleans Parish Medical Society, 1885; New Orleans Medical and Surgical Association (President 1889); Louisiana State Medical Society (President 1894-95); Honorary President, Pan-American Medical Congress, Washington, 1895 (Vice President for Louisiana, 1896); American Medical Association, Chairman, Section on Surgery, 1908; Vice President 1920; American Society of Clinical Surgery (Vice President, 1908-10); American Surgical Association (President, 1909); Southern Surgical Association (President, 1911; Honorary Fellow, 1928); American Association for Thoracic Surgery (President, 1920); Association of Military Surgeons, U.S.N.; American Association for Experimental Medicine; American Association of Anatomists; National Association for the Study and Prevention of Tuberculosis; American Association for Cancer Research; American Society for the Control of Cancer (Vice-Chairman A.C. 1926-); American Association for Endocrinology; Fellow, New Orleans Academy of Sciences; American Association for the Advance of Sciences; Honorary Member, Illinois Central and Mississippi Valley R. R. Surgeons, 1910; Honorary Member, New York Academy of Medicine, 1920; Honorary Member, American Society of Regional Anesthesia, 1923; Honorary

* *Who's Who In America*, 1929-30.

Member, Boston Surgical Society, 1926; American Society History of Medicine, 1928; Honorary Member Philadelphia Academy of Surgery, 1929; National Institute of the Social Sciences, N. Y.; American Association Friends of Medical Progress; American National Economic League; Louisiana Historical Society; National Geographic Society; Southern Art League, U. S.; Art Association of New Orleans, La.; New Orleans Zoological Society; American Museum of Natural History, N. Y.; Member and Rapporteur on Arterial Surgery (Section on Surgery) International Medical Congress, London, 1913 (by invitation); Member Association Française de Chirurgie (Rapporteur, by invitation, Congress and Honorary President 1922); Corresponding Member, Société Nationale de Chirurgie, Paris, 1923; Member, Société Internationale de Chirurgie (Rapporteur, by invitation, International Surgical Congress, Warsaw, 1929); Honorary President, Surgical Society of Barcelona, Spain, 1927; Honorary Fellow, Royal Academy of Medicine, Rome, Italy, 1927; Honorary Fellow, Catalanian Academy of Medical Sciences, Barcelona, 1928; Member, Société Internationale pour l'Histoire de la Médecine, Paris, 1926; Corresponding Member, Peruvian Surgical Society, Lima, 1920; Officer with decoration, Order of Public Instruction, Republic of Venezuela, 1925; Knight, Civil Order of Alfonso XII, of Spain, with decoration, 1929.

Editor, *New Orleans Medical and Surgical Journal*, 1883-1895.

Greek Letter Societies: Stars and Bars, Tulane Honor Scholastic Society (President, 1922); Nu Sigma Nu, 1915; Alpha Omega Alpha, 1916; Kappa Delta Phi, 1925.

Henry Bigelow Medalist of the Boston Surgical Society, Boston, Mass., November 1, 1926. Clubs: Boston, Round Table, Italian American Society.

A REPORT OF VASCULAR LESIONS

WHICH ILLUSTRATE SOME OF THE FUNDAMENTAL PRINCIPLES
THAT HAVE BEEN TAUGHT AND EMPHASIZED BY
PROFESSOR RUDOLPH MATAS

- A. ADVANTAGES OF THE REMOVABLE METALLIC BAND IN THE TREATMENT OF ANEURYSMS
- B. LENGTHENED AND TORTUOUS ARTERIOSCLEROTIC ARTERIES, WHICH MAY SIMULATE TRUE ANEURYSMS
- C. LIGATION OF THE THORACIC AORTA
- D. EFFECT OF ARTERIOVENOUS FISTULAE UPON THE HEART
- E. ARTERIAL DEGENERATION IN ASSOCIATION WITH ARTERIOVENOUS ANEURYSMS
- F. COLLATERAL CIRCULATION IN CASES OF ARTERIOVENOUS ANEURYSMS
- G. EFFECT OF CIRROID ANEURYSMS AND VENOUS ANGIOMAS UPON THE GROWTH OF EXTREMITIES
- H. ETIOLOGY OF CIRROID ANEURYSMS

MONT R. REID, M.D.

CINCINNATI, OHIO

INTRODUCTION

IN THE absence of any worthy experimental work or the use of new procedures in the surgery of the vascular system, I believe that I can best contribute my testimonial to this memorial volume by stressing and illustrating some of the important fundamental principles that have been, in a large measure, the fruit of Professor Matas's unmatched endeavor in this field. After all, he is the master of the knowledge, technique and history of vascular problems. In this field, as well as in many others, we turn to him for our knowledge and inspiration. The report of these cases in which I have both followed and not followed his teachings will, I hope, serve to point out the soundness of his wisdom in the handling of vascular conditions.

A. ADVANTAGES OF THE REMOVABLE METALLIC BAND IN THE TREATMENT OF ANEURYSMS

The value of this method of occluding any large artery, when subsequent conditions might arise to make a restoration of function of the vessel very desirable or vital, has been taught by Professor Matas for many years and has been amply proved by his own experiences. Halsted (1906) devised an ingenious instrument for rolling the aluminum band about the artery to be occluded, and advocated rolling it further between the fingers until the desired occlusion was obtained. Matas and Allen (1911) adopted the method of flattening the band to the desired point of occlusion, and have proved the value of this modification of Halsted's idea. It is true that the rolled band occasionally results in the projection of the inner end of the band into the wall of the artery in such manner as to produce greater damage to the arterial wall, and the author has adopted the Matas-Allen modification. Whichever method is used, the fundamental principle in the application of the band is the production of the least possible damage to the arterial wall and especially to the intimal surfaces.

CASE I. (M. 8420, Cincinnati General Hospital.) A colored man, aged twenty-nine, was admitted to the hospital on September 12, 1927, with a very pronounced pulsating exophthalmos of the right eye, which had resulted from a blow with brass knuckles behind the right ear four weeks previously. There was complete ophthalmoplegia due to the extreme exophthalmos. The eyelids were everted and edematous, the conjunctival veins were engorged and red, and the supraorbital veins were large. Vision was rapidly disappearing. A loud arteriovenous bruit could be heard over the entire head and the carotid vessels. Occlusion of the right common carotid artery by digital pressure caused a disappearance of the bruit and a marked recession of the exophthalmos. The rapid loss of vision and the youth of our patient caused us to decide on operation without waiting for or attempting to encourage the development of a collateral circulation.

September 13, 1927. The right external carotid artery was ligated with braided silk and the common carotid was gently occluded by a metallic band. The operation for some unknown and unjustified reason was done under ether anesthesia. The occlusion of the common carotid artery caused immediate cessation of the bruit and a recession of the eye. The operation

was done at 9 A.M. When I went on the ward at 5 P.M., the nurse reported that he had not "reacted" from the anesthetic. He was obviously comatose and completely paralyzed on the left side of his body. The band was

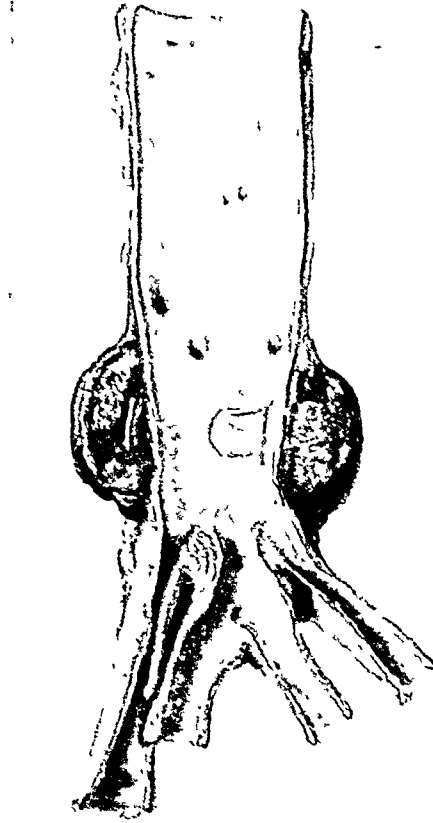


FIG. 1. Four months and twenty days after application of a rolled band to a dog's aorta. It was tightened until the thrill was very faint (not a complete occlusion). Note that the inner end of the band has cut through the wall and is projecting into the lumen.

immediately removed with an immediate return of the bruit. The bruit, however, grew fainter and was again completely absent at the end of five minutes. At the site of the band, above and below it, there was no evidence of a clot. Within three hours he began to show signs of consciousness and to move his left leg. At the end of five hours he was rational, could talk and was using his left arm and face to some extent. Improvement continued and at the end of twenty-four hours there was no evidence of any paralysis or cerebral disturbances. The bruit had not returned, the eye had ceased pulsating, the exophthalmos and edema had decreased markedly. On September 17 (five days after the operation), he was feeling so well that

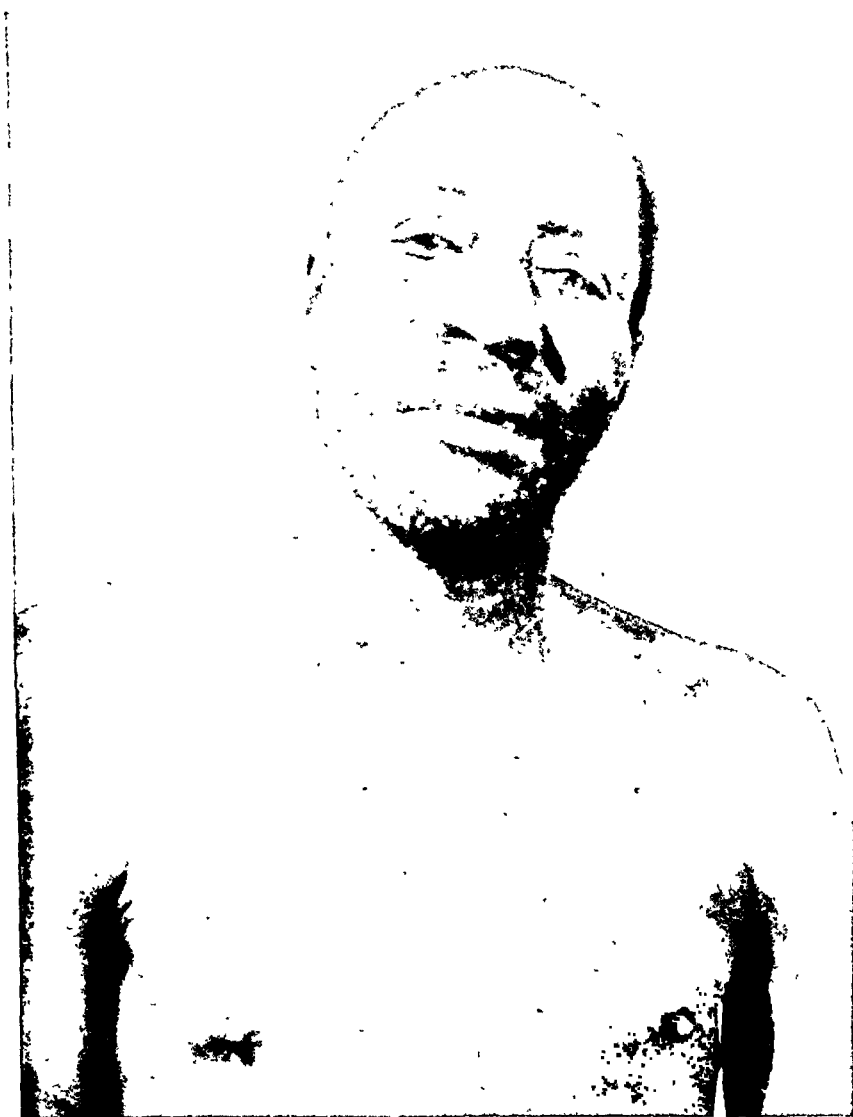


FIG. 2. Patient with a tortuous and elongated arteriosclerotic innominate artery, which simulated a subclavian aneurysm.

he got out of bed and left the hospital against advice. No activity was demonstrable in the arteriovenous aneurysm and the eye had returned amazingly rapidly to an almost normal condition. For five days after leaving the hospital there was no noise in his head, he felt well and his eye had become "all right." He refused to be quiet and went to work. Then he was seized with a sudden severe headache, the noises in his head reappeared and his eye protruded very rapidly. Four days later when he was admitted to the hospital the condition was the same or a little worse than it was at the time of the first admission.

On September 27, 1927, under local anesthesia, the common carotid artery was again occluded by the removable metallic band and the jugular vein was ligated with a silk ligature. The artery was carefully examined. It was found patent and there was no evidence of injury at the site of the previous band. The operation was done at 9 A.M. and careful notes were made every half hour during the day. He seemed perfectly well until 4 P.M. when a slight weakness of his left face was noted but no disturbance in his extremities. At 5 P.M., he was slightly stuporous, the left arm and face were completely paralyzed, the left leg was not affected. The band was immediately removed with a complete restoration of the function of the artery. There was no evidence of clot formation within the vessel. The bruit and pulsation of the eye did not, however, return. The paralysis improved and was noticeable only by a weakness of the arm, face and leg on the evening of September 29. On the 30th, the paralysis was more obvious and continued to grow worse until on October 3rd, there was almost a complete left hemiplegia. Improvement then began and by October 26, he was able to walk and could not be persuaded to stay in the hospital. The left arm was still paralyzed, the leg partially paralyzed, but the aneurysm was apparently cured.

May 9, 1930, he was again admitted to the hospital with extensive bilateral pulmonary tuberculosis and died on May 24. The eye was normal and there was no evidence of an intracranial arteriovenous aneurysm. There was a spastic paralysis of the left arm; the leg and face had almost completely recovered. The common carotid artery pulsated normally and showed no evidence of occlusion. Unfortunately an autopsy was not obtained.

This case illustrates several important points. The value of using the removable metallic band is well demonstrated. In this instance, the common carotid artery was twice occluded with the flattened band and the band was twice removed without causing a thrombosis at either site of its application. The



FIG. 3. Case of elongated and tortuous arteriosclerotic innominate artery, which simulated a subclavian aneurysm. 1. Bifurcation of the innominate into the subclavian and common carotid arteries. 2. Innominate artery. 3. Jugular vein.

application of the first metallic band resulted in a complete hemiplegia, which promptly disappeared when the band was removed nine hours after its application. The application of the second band resulted in a partial hemiplegia which promptly improved when the band was removed after an interval of nine hours. However, at the end of three days the paralysis began to progress and at the end of six days there was almost a complete left hemiplegia. Recovery from this was slow and never complete; at the end of twenty months he still had a spastic paralysis of the left arm.

It seems to me that in this case the cerebral conditions resulted from two distinct causes. There was cerebral anemia which was twiced caused by occlusion of the common carotid artery, and which was twice relieved by restoring the lumen of this vessel. Secondly, there were cerebral disturbances due to clot formation at the site of the aneurysm and the propagation of this clot into other vessels. When the first band was removed, activity in the aneurysm was immediately restored but ceased suddenly in about five minutes. The hemiplegia disappeared completely in a few hours. There was evidently a local clot formation at the site of the fistula, which did not extend into other vessels. About ten days after this apparent cure of his condition the clot was dislodged with a sudden restoration of all of his old symptoms. When the second band was removed, no activity was ever detected in the aneurysm; the paralysis improved rapidly for a few days and then gradually became worse, resulting in a total hemiplegia. This was evidently due to an extensive thrombosis spreading from a thrombus at the site of the aneurysm for there could be no question as to the patency of the common carotid artery. The danger of propagating thrombosis from the clotting of aneurysms has been stressed by Professor Matas and is one of his arguments for a direct surgical attack on aneurysms whenever it is possible.

This case also demonstrates the importance of adhering to his teaching that the adequacy of a collateral circulation should

be proved before operating for aneurysms. I have in mind a similar case that was treated by Professor Matas. He taught the patient to compress his own carotid artery for varying lengths of time until he could compress it indefinitely without causing cerebral symptoms. One day the patient said that he was ready for the operation because he could compress his artery as long as he wanted to do it without causing any dizziness or other evidences of an inadequate collateral circulation. In the case reported, such a procedure would have avoided the cerebral complications resulting from occlusion of the common carotid artery if we had not felt that the rapid destruction of the eye did not justify the delay. The danger of what really caused his permanent disability, namely, the propagating thrombosis from the site of the aneurysm, would still have existed.

In this case, the ether anesthesia almost resulted in a failure to detect the hemiplegia. Local anesthesia is far more preferable when operating on the large blood vessels, especially the neck vessels, for it gives one ample time to make observations on the collateral circulation and it gives one the cooperation of his patient.

B. LENGTHENED AND TORTUOUS ARTERIOSCLEROTIC ARTERIES, WHICH MAY SIMULATE TRUE ANEURYSMS

In my report of the aneurysms in The Johns Hopkins Hospital from the time of its opening to January, 1922, I included several cases in which a lengthened and tortuous sclerotic vessel was mistaken for a true aneurysm. In 1909, Dr. W. S. Halsted ligated the common carotid artery for what was considered an aneurysm of the innominate and subclavian arteries. The patient was a white woman, aged 60, who had a swelling 5 cm. in diameter just above the inner end of the clavicle. The Wassermann reaction was negative. Blood pressure, 220. Marked arteriosclerosis. For twelve years she was observed at frequent intervals and without noting any appreciable change in the condition. In 1921, we all agreed that the

condition had never been a true aneurysm, but simply a tortuosity of the subclavian and innominate arteries due to arteriosclerosis. Another similar case was recognized and not operated upon. In at least two other cases, one involving the common carotid artery, the other the subclavian, unnecessary operations were performed.

CASE II. About two years ago, a negro man, aged fifty-five (?), was admitted to the Cincinnati General Hospital with a diagnosis of a subclavian aneurysm. He had marked arteriosclerosis and a high blood pressure. The Wassermann reaction was negative. The swelling in the neck was due to a markedly lengthened and tortuous arteriosclerotic innominate artery, which had pushed up into and across the neck. The bifurcation of this vessel into the subclavian and common carotid arteries occurred at the junction of the middle and outer thirds of the clavicle. From this point, the carotid artery traversed the neck far lateral to the sternomastoid muscle instead of in its usual position near to the trachea.

C. LIGATION OF THE HUMAN AORTA

Of all the attempts to ligate the aorta, very few have resulted in any benefit to human beings. Professor Matas' endeavor in this line has been noteworthy for its success. In view of his interest in this subject, I wish here to record two recent ligations of the thoracic aorta.

The technical procedure of ligating the aorta is not difficult, but the difficulty has been to ligate it in such manner as to result in a permanent occlusion of its lumen. Ligations with silk ligatures, tapes, bands, etc., have frequently cut through the arterial wall, resulting in a fatal hemorrhage or a re-establishment of the lumen within a few days or weeks after the operation. To avoid this danger, Dr. Halsted and I experimented with the use of fascial plugs that could be introduced into the lumen of the dog's aorta and there anchored. With this method we had uniform success. It is the method that was used in the two cases here reported.

CASE III. A negro woman, aged thirty-five years, was admitted to the Cincinnati General Hospital on July 11, 1928, with a luetic abdominal aneurysm. It arose from the posterior part of the aorta just above the

coeliac axis and was causing a marked erosion of the twelfth thoracic and first lumbar vertebrae. It also extended into the region of the left psoas muscle, causing the usual radiating pains into the left leg. The heart



FIG. 4. Thoracic aorta temporarily occluded by rubber tubing, and the fascial plug in place ready to be sutured.

was not enlarged; pulse, 80 and regular, blood pressure 145/40; general condition, good.

With absolute bed rest for eighty days, during which time antiluetic treatment was given, the aneurysm grew definitely larger and more painful.

Operation, October 2, 1928. Intratracheal ether anesthesia was used. About 6 or 8 inches of the left ninth rib were excised. The parietal pleura was stripped from the chest wall for considerable distance. It was then opened. The ribs were spread far apart and this gave us an excellent exposure of the thoracic aorta. It was freed by means of staphylorrhaphes. The intercostal vessels coming off it were ligated with silk. The vessel did not seem particularly sclerotic; that is, it did not contain calcified

plaques in its wall. Some large tapes were introduced around the aorta and separated and twisted until the blood current was cut off. We watched the effect of this for some little time and had Dr. Morris watch the patient's pulse. After the aorta was thus occluded, the radial pulse became much stronger but the heart did not seem to dilate. Consequently we opened the aorta between the temporary occluding ligatures and filled it with a ball of fascia that had previously been taken from the right thigh by Dr. Bell. The ball of fascia was securely anchored in place by through-and-through mattress sutures of heavy braided silk. The opening in the aorta was closed with double medium silk sutures which included the fascial plug in them. On removal of the temporary ligatures of tape there was no bleeding at the point of operation. Everywhere the wound was dry and consequently it was closed tightly with interrupted silk sutures. The patient seemed to stand the operation surprisingly well.

The operation was done at 9 A.M. At 4 P.M. her general condition was very favorable. The pulse was of fairly good volume. The circulation in her legs seemed adequate, although no pulse could be felt in either extremity. At 6 P.M., evidences of shock began to develop; pulse 128; blood pressure, 90/70. In spite of stimulation and intravenous therapy this condition progressed until at 10 P.M., twelve hours after the operation, the patient died.

At autopsy, it was discovered that death had resulted from hemorrhage that came from the divided intercostal artery at the posterior part of our incision into the chest wall. No bleeding had occurred at the site of the occluded aorta. This vessel was removed and subjected to a high pressure of water without any leakage at the site of operation.

CASE IV. A negro man, aged fifty-seven years, was admitted to the Cincinnati General Hospital March 19, 1929, with an abdominal aneurysm. A diagnosis of an abdominal aneurysm had been made three years previously, but with antileptic treatment, the patient had been fairly comfortable and able to work until four months before admission. Then pain in his back and left leg forced him to become an inmate of the County Home for incurables. Clinically, the aneurysm was in the lower epigastric region, and extended into the left psoas region. Pulsation in the left lumbar region was easily detected. The left leg was flexed. The patient suffered excruciating pain. The right femoral pulse was absent; the left was apparently normal. The heart was normal in size, pulse 100, blood pressure 150/120.

Operation, May 17, 1929 (Dr. W. DeW. Andrus). Intratracheal ether anesthesia was used. An incision, about 6 inches long, was made on the right side of the chest, one inch lateral to the spinal column and extending

out along the tenth rib. The structures beneath this were incised and separated, the ribs were exposed and portions of about 5 inches of the ninth, tenth, and eleventh ribs were resected. The intercostal muscles and vessels were transfixed and ligated, the parietal pleura was stripped away. The aorta was exposed and two tapes were passed about it about $1\frac{1}{2}$ inches apart. It was our plan to cut into the aorta and insert a plug of fascia lata which had been removed from the left thigh. The tapes were twisted down until the blood current was shut off. The blood pressure had been taken just before ligation of the aorta, and was found to be 130/100. Immediately following the obstruction of the blood current, it was found to be 180/130. The pulse was rather slow and became more bounding in the temporal artery. Upon making a longitudinal incision into the aorta the intimal coat was found to be so sclerotic that it exuded from the vessel. It was found to be impossible to place the fascial plug in position and suture the vessel over it, because the suture tore out of the vessel when any strength was placed upon it. The tapes which were already in place were therefore used and the aorta was ligated and divided between ligatures at the level of the eleventh thoracic vertebra. The wound was closed with interrupted medium silk sutures for the fascia and interrupted fine silk for the skin. No drainage.

The patient died, apparently from shock, about one and a half hours after the completion of the operation.

At autopsy about 400 c.c. of blood were found in the right pleural cavity although the parietal pleura appeared to be intact. No hemorrhage had occurred at either end of the ligated aorta.

D. EFFECT OF ARTERIOVENOUS ANEURYSMS UPON THE HEART

I am very happy to report in detail in this volume an unusual case of cardiac disturbance following a femoral arteriovenous aneurysm, for, largely due to Professor Matas, the medical profession has become more thoroughly acquainted with the effect of this condition upon the heart. This report is made with the consent of Dr. V. R. Mason of Los Angeles, California, who immediately recognized the nature of his patient's trouble and asked me to come to California to operate for him. I have referred to this case in a brief footnote in the chapter on the surgery of the Arteries in Nelson's Loose Leaf Surgery.



FIG. 5. Occlusion of the thoracic aorta by means of the anchored fascial plug. The incision into the aorta has been sutured. The through-and-through mattress sutures of silk are ready to be tied. Insert shows the anterior and posterior views of the completed operation.

On his first visit, June 26, 1928, Dr. Mason made the following note:

CASE V. The patient is undernourished. The lips are very red but not cyanotic. The skin is clear. No angiomas. The sclerae are a bit subicteric. The lungs were not examined. The veins of the neck are full in every position. The veins on the back of the hand collapse about 12 cm. above the heart level. At about 10 cm. they pulsate noticeably. Heart, apparently absolutely irregular but not just like the ordinary atrial fibrillation. Relative cardiac dulness in about 13×6 to 7 cm. It is definitely a globular heart. No significant murmurs. Abdomen is distended with fluid. No viscera are felt. There is moderate edema of the legs, especially of the right. Just over Scarpa's triangle is a fusiform pulsating swelling over which is a continuous thrill, felt to the end of the toes. Over this there is a loud continuous murmur accentuated at systole. The pulse is about 100. The blood pressure is 150/60; when the fistula is occluded it is 155/90. This was repeated with essentially similar results. Although the force of the beats varies, I believe that these results represent fairly accurately the change when the fistula is closed.

Impression. 1. Arteriovenous fistula. 2. Cardiac failure, secondary to No. 1. June 29, 1928, blood pressure, 160/70 with fistula open; 165/90 with fistula closed. The patient's abdomen was tapped and about 8 quarts of fluid were removed. After the tapping, the blood pressure was 130/65 with the fistula open; 140/80 with the fistula closed. The liver is enlarged. The edge is about two fingerbreadths below the costal margin. It is smooth, not definitely pulsating.

Electrocardiogram. July 1, 1928. Atrial fibrillation of the fine type. No spaced P waves. Low voltage in lead III. T_3 inverted. T_1T_2 upright. No ventricular preponderance. No slurring nor splintering of QRS except in lead III. Lead I: with fistula open, rate 90; with fistula closed, rate 78; Lead II: with fistula open, rate 90; with fistula closed, rate 90; Lead III: with fistula open, rate 97.5; with fistula closed, rate 84. The lungs are clear except for numerous râles over the right upper chest. The x-ray of the chest shows some fibrosis and a moderately large globular heart.

When I arrived in Los Angeles, Dr. G. H. Ernsberger who had assisted at a previous operation and who had observed the patient ever since, gave me the following notes:

Complaints. Swelling of the abdomen and legs, especially the right one; feelings of fullness in the head; easily fatigued; thrill that can be felt in the upper part of the right thigh.

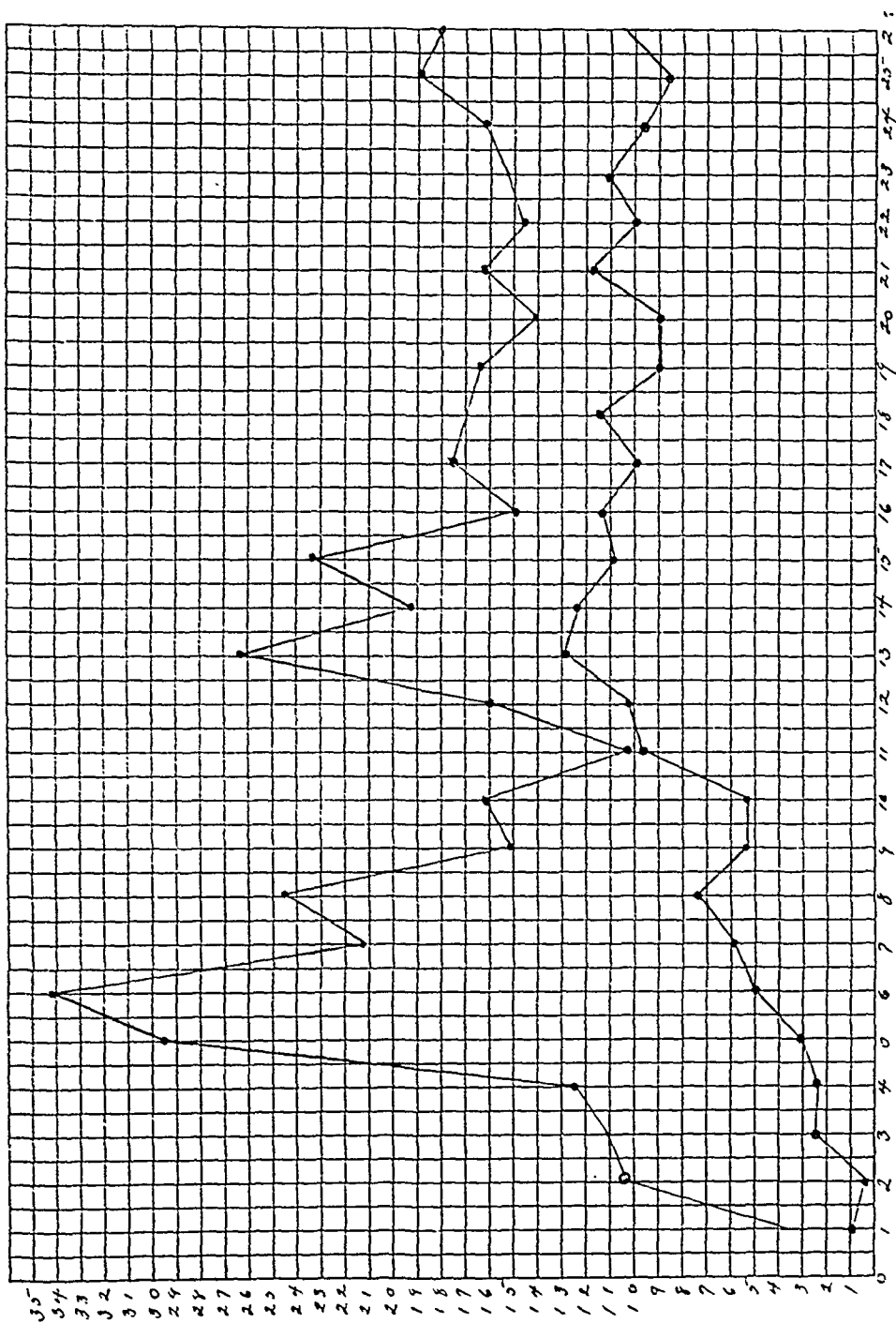


FIG. 6. The fluid intake (red) and urinary output (black) are charted for twenty-six days following operation. On the sixth day the urinary excretion was 3400 c.c., the fluid intake, 500 c.c. On the eleventh day the intake and output were almost the same, and it was on this day that the wound was opened because of infection. Note the gradual fall of urinary excretion before and the sudden rise after the drainage of the infection.

On August 13, 1924, the patient was shot through the right thigh from back to front, just above the middle, with a 38/ revolver. The wound bled at the time, but not profusely. Eight days later a pulsating expansile tumor was found beneath the wound of exit. This enlarged rather rapidly for about four weeks and then remained stationary in size, being approximately 6 cm. in diameter. Over the tumor mass there was a systolic thrill, and a thrill could be felt along Hunter's canal and as high as Poupart's ligament. There was a characteristic aneurysmal bruit audible over the same area. The posterior tibial artery on this side was palpable only when the swelling was compressed. There was no edema of the right leg. These were the findings as they existed on September 30, 1924 when he was operated upon by Dr. Roland E. Skeel. His physical examination other than the foregoing showed no important abnormalities. The condition of his heart was good, showing no signs of decompensation; his blood pressure was 140/90.

At the operation there was found an aneurysmal sac arising from a vein which was anterior to the superficial femoral artery. There was an opening between the posterior surface of this vein and the anterior surface of the artery. This venous sac was about the size of a walnut and had dissected its way directly into the body of the sartorius muscle. A tourniquet was applied above the site of the operation and the opening of the vein into the sac was sutured with fine silk and, after separating the vein and artery, the communicating openings were also sutured with fine silk. The vein in question was tied below the point where it crossed the artery. The muscles were sutured over the repaired vessels.

On October 5, there was found to be a distinct thrill from Poupart's ligament to the middle of Hunter's canal when slight pressure was made over the wound, but when very light touch was used no thrill could be felt. There was no expansile pulsation and the circulation in the foot was good. The wound healed with no infection, but there was a small amount of blood and serum evacuated on the ninth day. The thrill continued to be felt during the next two weeks while he remained in the hospital, but did not seem to increase.

On October 15, a note was made that the posterior tibial artery was distinctly palpable without pressure being made over the wound. There was some swelling of the right leg when the patient got out of bed about November 15.

During the past four years this thrill has persisted, and has increased in intensity. There has been a moderate increase of swelling of the right leg. The patient had not been inconvenienced by pain or other unusual symptoms until December 15, 1927, when he became ill with an attack of influenza, subsequent to which he developed a fibrillating heart, edema of both legs and abdominal ascites.

In January last, he was put to bed and has remained in bed since then. With large doses of digitalis and a limited amount of fluids, the heart condition has improved and the general tissue fluids have diminished but the fibrillation has continued almost constantly since that time, as has the ascites for which he has been tapped several times. The urine during the past four years has shown a slight to a heavy trace of albumin and a few hyaline casts. His blood pressure has remained fairly constant at about 140/90. Occasionally the blood pressure has been found to be as high as 160, sometimes as low as 120.

The following note was made by me on July 11, 1928:

The patient is a white man, fifty-seven years old, presenting the picture of rather extreme circulatory failure. The eyelids are puffy; face, slightly swollen and subicteric in color; lips and mucus membranes definitely cyanotic; veins of the neck, distended and pulsating; slight but definite generalized edema of the extremities; very marked ascites; a large fibrillating heart. The story is that on August 12, 1924, he was shot through the right thigh with a 38/ revolver, which established a communication between the femoral artery and vein (arteriovenous aneurysm). On September 30, 1924 (about six weeks after the accident) an unsuccessful attempt to close this fistula was made. The records show that at that time his heart was regarded as normal. In the four years since then he has developed a very large fibrillating heart associated with decompensation and ascites as noted above and more carefully in the notes of Dr. Mason and Dr. Ernsberger. Several abdominal tapplings, with the withdrawal of as much as 18 liters of fluid, have been necessary. There is a well-healed scar over the right Scarpa's triangle, measuring about 7 inches in length. There are the evidences of a large arteriovenous communication between the femoral vessels at about half the distance between the profunda artery and the apex of the triangle. The thrill and continuous bruit are easily detected all the way to the foot and upward to the bifurcation of the aorta. The bruit can also be heard in the left femoral artery. They are most intense directly over the fistula. Occlusion of the fistula makes them disappear entirely. At the site of the fistula, there appears to be an aneurysmal dilatation about the size of an egg. Whether this is on the artery or vein I cannot say. The artery proximal to the fistula is tremendously dilated all the way to the bifurcation of the aorta and this latter vessel is almost certainly dilated but cannot be demonstrated on account of the ascites. At Poupart's ligament the femoral artery is at least four times larger than normal. This vessel is a little tortuous. There is not a marked angiomatous condition in the subcutaneous tissues, due probably to the location of the fistula and the fact that the long saphenous vein was certainly sacrificed

at the first operation. There is considerable edema of the right leg (more than in the left). Below the knee there is rather marked pigmentation of the skin but no ulceration or scars indicative of previous ulcers. The pulse in the foot is easily felt but it is smaller in volume than it is in the opposite foot. Occlusion of the femoral vessel at the site of the fistula increases the volume of the pedal pulses. The effect of this maneuver on the heart, pulse rate and general blood pressure is carefully recorded by Dr. Mason. The right foot feels a little colder than the left. The general venous pressure is obviously elevated as noted by the dilated veins in the neck and extremities and by the fact that the superficial veins do not collapse until the extremities are raised well above the level of the heart. This is not true when the fistula is closed by compression. The artery beyond the fistula cannot be felt and is obviously small. The fistula is on a line directly between the scars of the points of entrance and exit of the bullet.

Impression. A large right femoral arteriovenous aneurysm of four years duration, which has resulted in a large fibrillating heart and general anasarca due to decompensation of the heart.

Recommendation. The segments of artery and vein bearing the fistula should be completely excised. There is already an adequate collateral circulation as shown by the effect on the pedal pulses of occluding the femoral artery. The femoral artery is obviously markedly degenerated and no effort to restore it to function should be made.

Operation July 12, 1928. The operation was done without a tourniquet and under local anesthesia. Due to the scar tissue from the previous operation and the great vascularity the time required to complete it was over three hours. We excised the artery and vein at the site of the fistula and ligated the four ends of the divided vessels with heavy braided silk. The wound was closed without drainage.

The artery proximal to the fistula was four times as large as the distal portion. The vein was markedly enlarged, especially on the cardiac side of the fistula. The fistulous opening measured 1.5 cm. in diameter. The artery below the fistula, the wall of the vein opposite it and the edges of the communication showed a marked sclerosis with calcification. The artery proximal to the fistula was extremely thin-walled and resembled a vein. This large opening, together with the previous ligation of the distal vein, allowed an unusually free shunting of the arterial blood back upon the heart. After the operation was completed, the dorsalis pedis pulse was apparently as good as in the opposite foot.

Ten days after the operation it was necessary to open the wound because of a mild staphylococcus infection. It was opened widely and Dakinized very freely for about two weeks. Complete healing occurred without sloughing or a discharge of the heavy braided silk sutures.

There was an astonishingly quick change in the condition of the patient following operation. By evening of the day of the operation, the cyanosis had disappeared, the veins of the neck were collapsed and the heart was perceptibly smaller and more regular in action. From day to day, the decrease in the size of the heart was very striking and in less than a month it had reduced in size from a large heart to one of almost normal size. At that time there was, however, some atrial fibrillation still present. The temperature of the right foot was strikingly elevated for several weeks after closure of the fistula. The pedal pulses remained as good as they were in the other foot.

A most astounding effect of the operation was the rapidity of the disappearance of the anasarca. Beginning on the day of operation, the urinary output far exceeded the fluid intake; on the fourth day this amount was almost five times as great as the amount he drank. By the tenth day he had lost nearly 50 pounds in weight, due almost entirely to the excessive urinary excretion. The patient complained that he had to void so frequently he could not sleep. In a week the tremendous ascites was practically gone and the intestinal patterns could be seen through the relaxed and thinned abdominal wall. Due to loss of fluids the patient's face and extremities seemed emaciated; the skin became relaxed and wrinkled.

The operation was done on July 12, 1928. For about six months prior to this, he had been bedridden and tapped frequently under the impression that he had a hopeless case of cirrhosis of the liver. In the late autumn after the operation, he reported to me that he was able to attend to his usual duties and to play golf. I have never seen nor heard of such a damaged heart due to an arteriovenous aneurysm nor such a remarkable recovery after its removal.

A fuller report by Dr. V. R. Mason, giving careful electrocardiographic studies of the heart and chemical studies of the urine and blood will certainly appear before long.

E. VASCULAR DEGENERATION IN ASSOCIATION WITH ARTERIOVENOUS ANEURYSMS

The artery proximal to a fistula tends to degeneration; its walls become thinned, muscular and elastic tissues atrophy, and in many cases it assumes the appearance of a vein. I have cited reports in which aneurysms have developed in this proximal vessel. In one case an aneurysm developed in the proximal artery six years after the closure of a fistula, with restoration of the artery and vein. The wall of the involved

vein becomes thicker and hypertrophied. I have previously suggested¹ that the alterations in the pulse pressure might be responsible for this atrophy of the artery and hypertrophy of

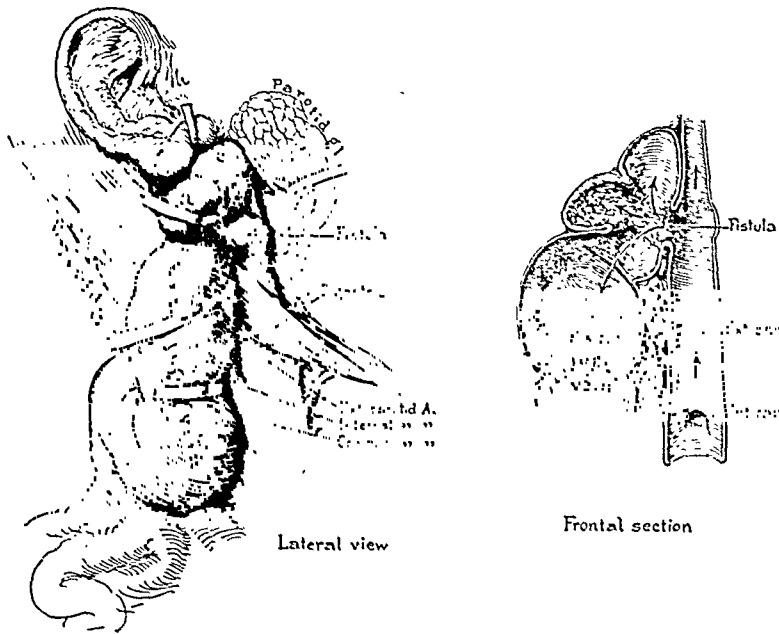


FIG. 7. Arteriovenous aneurysm which had been present for thirty-two years. Age of patient, thirty-four years. Note calcification of vein, and relative thinness of arterial wall as compared with that of the vein.

the vein. Certainly, some fundamental principle, such as nutrition of the vessel walls or exercise, is involved in these changes.

In addition to the foregoing changes, there is usually a very marked deposition of calcium in the rim of the fistula and especially in the wall of the vein directly opposite to the fistula. This was very pronounced in the case of a thirty-four year old woman who had had a fistula between the external carotid artery and external jugular vein for thirty-two years. There was no evidence of any other arteriosclerosis.

F. THE COLLATERAL CIRCULATION IN CASES OF ARTERIOVENOUS ANEURYSMS

A great many years ago Professor Matas observed a very rapid return of a peripheral pulse after the tying of both artery

¹ *Arch. Surg.*, 2: 24-42 (July) 1925.

and vein for an arteriovenous aneurysm. In Holman's remarkable case, an absent pulse in the foot could be made to appear and become strong simply by compressing the arteriovenous



FIG. 8. Injection preparation showing effect of an arteriovenous fistula on the development of collateral circulation in the dog. An arteriovenous fistula was established between the femoral artery and vein on the right, while the left femoral artery was ligated at the same level. Duration of experiment, five months

fistula. In one of my patients who had had a femoral arteriovenous aneurysm for nine years, no pulse could be felt in the foot. Immediately after excision of the aneurysm (artery and vein)

a good pulse appeared in both the dorsalis pedis and posterior tibial arteries; within twenty-four hours, the pulse in this foot was actually fuller and stronger than it was in the normal foot. Observations of a similar nature have been made by Gehle and Keys, Krammerer and, more recently, by many others.

These observations led me to attempt to demonstrate experimentally the effect of arteriovenous fistula upon the collateral circulation. We have made these experiments upon a great many dogs and have x-rayed the arterial system, after closure of the fistula, at varying lengths of time following the operations. In from three to six months, an enormous collateral circulation develops. It is many times greater than in the leg when a simple ligation of the artery or of the artery and vein is done. The embarrassment to circulation following an arteriovenous aneurysm would seem to be much greater than that due to an occlusion of the artery, and consequently, the cause of a much more prodigious development of a collateral circulation. For this reason, we counsel delay in operating on arteriovenous aneurysms whenever the effect on the heart, or, for purely local reasons, an immediate operation is not demanded. After five or six months, the operation is technically easier and the involved vessels may be sacrificed without fear of an inadequate circulation.

In cases of arteriovenous aneurysms, when a direct attack on the fistula is ultimately contemplated, we do not believe that artificial means to stimulate a collateral circulation are indicated. The greatest stimulus is already present. In cases of pulsating exophthalmos, when a direct attack on the fistula is not possible and when one cannot always wait long, the situation is different. Here one is reduced to the notoriously dangerous procedure of ligating an artery proximal to an arteriovenous aneurysm. In such cases, Matas' method of testing whether the artery can be ligated should be done. It is entirely possible that a proximal ligation of the artery is more dangerous in old cases than it is very shortly after the fistula is produced.

G. THE EFFECT OF CIRROID ANEURYSMS AND ANGIOMATA ON THE GROWTH OF EXTREMITIES

As far back as 1854, Giraldes noted the lengthening of a limb in a case of cirroid aneurysm. Ten and thirteen years later, similar observations were made by Cordonnier and Hewett. In this century several observers have confirmed these earlier reports, so that now the overgrowth of an extremity involved in a cirroid aneurysm is fairly well known to any surgeon interested in vascular conditions. The fundamental reason is the more than normal supply of arterial blood to an extremity during its period of growth. So far as I can learn there has not been reported an overgrowth of bone when the cirroid aneurysm has occurred after ossification of the epiphyseal lines. In this connection the late Professor Halsted was always interested in the lengthening of bones in cases of chronic osteomyelitis of children. We measured and studied several cases in which the bones of the affected legs were several centimeters longer than the corresponding normal bones. It was our belief that the increased blood supply due to the prolonged inflammation was responsible for the excessive growth.

If over-arterialization will cause overgrowth of a part, then it would appear reasonable to expect undergrowth of a part in some cases of venous stasis. There are cases of extensive venous angiomas in which the capillary bed is apparently normal, and in which nutrition of the part is probably below normal. In many respects, this condition is directly opposite to the condition that prevails in cases of cirroid aneurysms. In 1925, I gave a short abstract of a case in which retarded growth was associated with an extensive venous angioma of the leg. The patient was then thirteen years old. I wish now to present some further observations upon this case, and, in order to contrast it with the effects of over-arterialization I will summarize a previously reported case of cirroid aneurysm.

CASE VI. In 1921, I operated upon a white woman, aged thirty-five, who had had a cirroid aneurysm of the entire right lower leg since birth.

Throughout the tibia there were numerous free communications between the arteries and veins and all of the large superficial veins pulsated and carried arterial blood. This case has previously been reported in detail¹

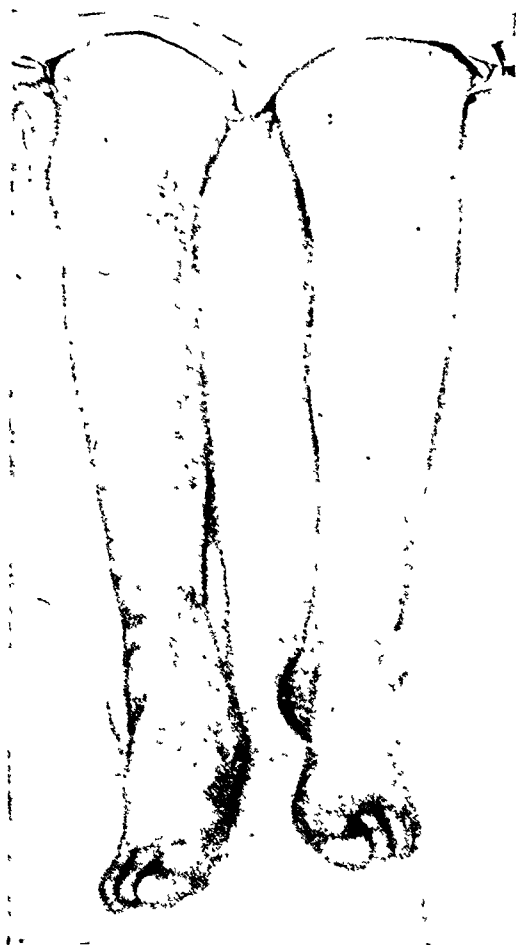


FIG. 9. A congenital cirroid aneurysm of the right leg. Age of patient, thirty-five years. Right tibia was 5.75 cm. longer than the left. All of the bones of this leg were larger than those of the other leg.

but I wish here to call attention to the fact that the right leg measured in length 6 cm. more than the left leg. The actual length of the right tibia was 5.75 cm. longer than the left.

The case of venous angioma was first seen by me December 10, 1923. At that time, the following note was made:

¹ *Arch. Surg.*, 10: 601-638 (March) 1925.

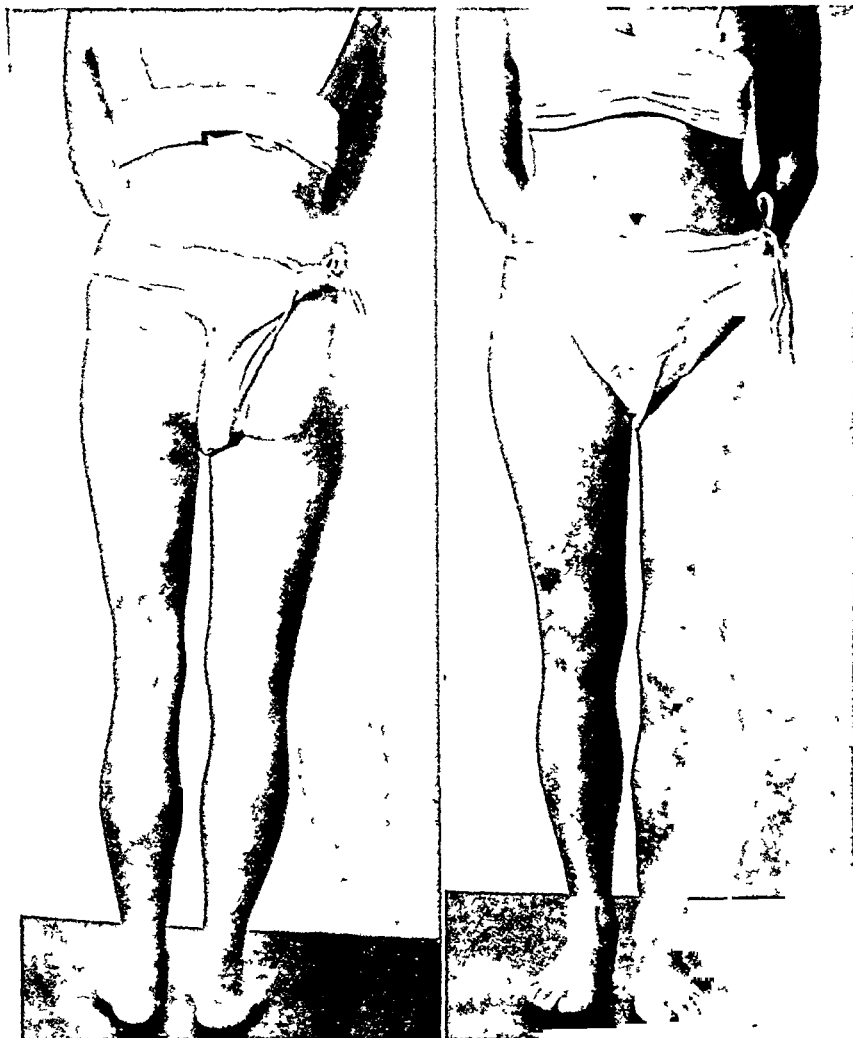


FIG. 10. Anterior and posterior views of patient with a venous angioma of the left leg. Note lack of development of this leg. Surface croppings of the angioma can be seen in the toes and over the buttock.

CASE VII. The girl, aged thirteen, was born with a bluish discoloration of the heel and outer aspect of the foot and the posterior part of the leg all the way to the buttock. Very little attention was paid to this condition until, at the age of four, the child developed trouble with the left knee. As a result she was given a series of nine or ten roentgen-ray treatments without any beneficial effect. Since that time she had had numerous attacks of disability in the left knee, which often necessitated her staying in bed for several days or weeks. There was no history of chills, fever or vomiting associated with these attacks; nor do they follow as a result of localized infection, such as tonsillitis. It had been noted by her friends that she limped and that the left leg was a little shorter than the right.

The examination showed that the entire left leg and foot were smaller than the right. The left leg was much paler than the right, except at points where the angiomatous condition came to the surface.

The following measurements were made: Left tibia, 34.25 cm.; right tibia, 35.25 cm. left femur from trochanter to condyle, 35.5 cm.; right femur from trochanter to condyle, 39.25 cm. Anterior superior spine to internal malleolus, left, 81 cm.; right, 82.5 cm. Circumference of calf, left, 29 cm.; right, 32 cm. Left knee, 28.5 cm.; right knee, 31.25 cm. Left thigh (measuring $9\frac{1}{2}$ inches (24 cm.)) above knee, 40 cm.; right thigh, (measuring $9\frac{1}{2}$ inches (24 cm.)) above knee, 44 cm. Length of sole of foot, left 22.5 cm.; right, 23.5 cm.

A very interesting point was that the child complained very frequently of being dizzy when she assumed a standing position after lying down. This is slightly present now on examination. It is very likely that when she stands up suddenly a great deal of blood is shunted into the angiomatous area so that the dizziness is due to anemia of the brain.

October 13, 1930. The patient is now twenty years old. About once a year she is incapacitated for a week or ten days because of haemorrhage into the knee joint. The rest of the time her activities are not especially limited.

The surface appearances of the angioma in the foot, posterior part of the leg and thigh and over the buttock, do not seem to have progressed in the last seven years. The contrast in size of the two legs is more marked. The left foot is strikingly smaller than the right; the entire left leg appears much smaller and shorter. The muscles of the left thigh and calf are much softer and more flabby than those of the right leg. However, when the patient stands the blood vessels become distended and cause the muscles of the left leg to appear much firmer. Muscular strength in the left leg is definitely reduced. Due to the shortness of the left leg the patient walks with a little tilt of the pelvis, but without any noticeable limp.



FIG. 11. Foot prints of the patient with atrophy of left leg due to an extensive venous angioma. The sole of the left foot is $\frac{1}{2}$ inch shorter than that of the right foot. Prints made October 16, 1930.

The following measurements were made. Left tibia, 34 cm.; right $36\frac{1}{2}$ cm. Left femur from trochanter to condyle 40 cm.; right, 40 cm. Anterior superior spine to internal malleolus, left 83 cm.; right 84 cm.

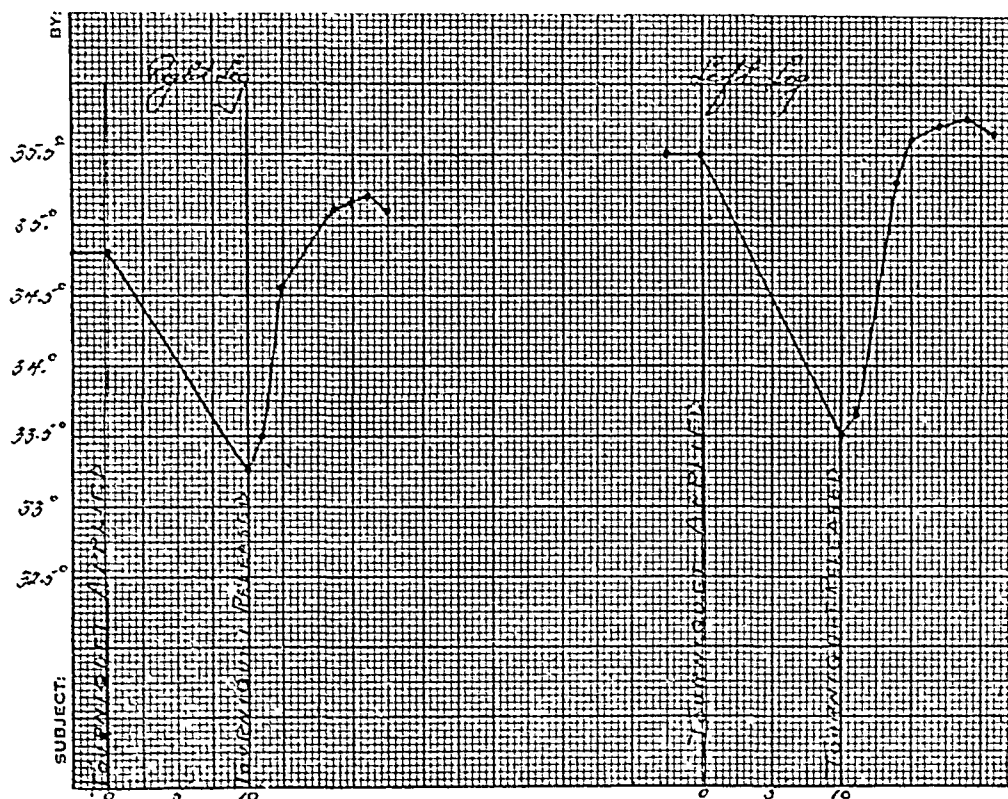


FIG. 12. Studies of the temperature by means of the thermocouple in the case of congenital venous angioma of the leg. Temperature of the left leg is normally a little higher than it is in the right one. However, it drops more rapidly and rises more slowly and relatively less high with the application and release of the tourniquet.

Circumference of calf, left, 31 cm., right 33 cm.; left knee, 27 cm., right $32\frac{1}{2}$ cm.; left thigh (24 cm. above the knee), $44\frac{1}{2}$ cm., right $49\frac{1}{2}$ cm. Length of sole of foot, left 20 cm., right, 24 cm. From these measurements it would appear that the left foot is even a little smaller than it was seven years ago.

With the patient lying down, the blood pressure is 130/85 and the pulse rate is 86. Immediately after standing the blood pressure is 126/84, the pulse 116, and there is slight dizziness, but this is not as noticeable as it used to be. After standing for ten minutes, the pulse rate drops to 104. Immediately after lying down and holding both feet up in the air the pulse rate becomes 88; the blood pressure remains 130/84. In the recumbent position the blood pressure in the left leg is 134/85, in the right leg, 165/125.

Observations on the temperatures of the two legs are made by means of the thermocouple (see Fig. 12).

It seems certain that the impaired circulation is due to the venous angioma and that, as a result of poor nourishment, the left leg has failed to develop normally. This is in quite striking contrast to the over-development that may result from cirroid aneurysms. In this case the capillary bed is probably normal but the large angioma on the venous side of it definitely embarrasses circulation. In cirroid aneurysms, there is an overabundance of arterial blood without any obstruction to venous return.

H. THE ETIOLOGY OF CIRROID ANEURYSMS

In other papers I have discussed at length and have cited many instances in support of my conviction that cirroid aneurysms and arteriovenous aneurysms are essentially the same condition and result from the same etiologic factors. They are both abnormal arteriovenous communications and may be either traumatic or congenital in origin. I wish here to report two more cases of cirroid aneurysms which were the direct result of trauma. In one case the cause was a contusion, in the other it was a penetrating wound.

CASE VIII. A white girl, aged twenty-nine, was first admitted to the hospital in April 1928, complaining of a swollen reddish area on the dorsum of the right foot. Until the age of seven, both feet were normal. At that time a porch bench was dropped on her right foot. The skin was not broken, but there resulted a marked swelling and extensive ecchymosis. With the subsidence of these signs it was noted that a little swelling persisted on the dorsum of the foot just at the site of the blow. During the succeeding twenty-two years, or up to the time that I first saw her, this small area grew slowly in size, became reddish in color and in recent months had given rise to occasional severe hemorrhages.

On the dorsum of the foot there was a reddish warty or telangiectatic area about the size of a silver dollar. This area pulsated and over it a faint systolic thrill could be felt. The veins of the foot were markedly dilated, pulsated and obviously carried arterial blood. A loud continuous bruit with systolic intensification could be heard over the entire foot. This was most pronounced over the red area where firm pressure appeared to



FIG. 13. Case of cirroid aneurysm caused by a blow on the dorsum of the foot. Age of patient, thirty years. Duration of aneurysm, twenty-three years. The dotted lines represent the sites of the five operations. The stars represent the two points where bruits can now be heard.

obliterate completely the thrill and bruit, and resulted in a collapse of the veins with a cessation of their pulsation. The dorsalis pedis, anterior and posterior tibial arteries appeared to be fully two or three times their normal size. The popliteal artery was not demonstrably enlarged. The blood pressure in the right thigh was 160/130, in the left 130/80, in either arm it was about 112/80. The right foot was definitely longer and larger than the left one. She had to buy shoes a size too large for the left foot in order to have the right foot fitted. The foot, ankle and lower part of the leg were warmer than the corresponding parts of the other leg, and exhibited a more luxurious growth of hair. X-ray of the foot revealed no abnormalities of the bones.

Operation was performed under ether anesthesia, April 28, 1928. As is customary in any vascular case, the skin was sterilized with iodine and then covered with collodionized china silk. A tourniquet was applied to the thigh. Through a straight dorsal incision the subcutaneous vessels including the dorsal pedis artery were removed. They were found to be intimately connected with the tendons and large thin-walled vessels extended in between the bones of the foot and ankle. Bleeding points were ligated with silk ligatures and the wound was closed with silk sutures.

About one week after this operation, a faint bruit was detected over the outer side of the foot and about the ankle. Occlusion of the posterior tibial artery seemed to stop it. On May 12, 1928, this vessel was ligated under local anesthesia. A couple of days later the bruit was still audible and on May 16, a large branch of the anterior tibial artery just above the ankle was also ligated. Following this and up to the time the patient left the hospital, there were no definite evidences of any abnormal arteriovenous communications.

February 23, 1929, the patient was again admitted to the hospital for study and treatment. She had been working regularly for almost nine months when a little swelling and subsequent oozing of a pale colored fluid had developed at the lower end of the scar. On examination a small infected stitch was removed from this point, with the result of a very prompt healing. No pulsation, thrill or bruit could be detected in the region of the discolored area. However, on the lateral aspect of the dorsum of the foot and extending up toward the external malleolus a faint but distinct bruit could be heard. Just anterior to the external malleolus a rather large artery could be felt, occlusion of which caused the bruit to disappear. On February 28, this vessel was exposed and about $2\frac{1}{2}$ inches of it removed. It extended under the annular ligament, was as large as a normal dorsalis pedis artery and seemed to us to anastomose definitely with veins. She remained in the hospital eighteen days. During this time a bruit was not heard. Examination after she had been on her feet for twelve

days revealed a faint bruit on the inner side of the ankle joint and about the heel.

April 1, 1929, an incision 3 inches long was made just above the external malleolus and parallel to the tendo Achillis. Through this incision we again ligated the posterior tibial artery and excised a large aberrant branch of the anterior tibial running just behind the fibula. A week later the patient was again discharged from the hospital with no audible arterio-venous communication present. No distended and pulsating veins had ever developed since the first operation.

September 18, 1930. Since being in the hospital, the patient has been very comfortable and has carried on her work without any difficulty until the last two or three days when there has developed a little redness, swelling and soreness on the outer side of the dorsum of the foot. The dorsum of the foot is still slightly reddened, hot and shows definite evidences of mild infection. There is no fluctuation and it appears that the infection may subside. The veins of the foot and ankle are still slightly dilated when she stands. When she lies down, they collapse entirely except just in front of the ankle joint. No thrill can be felt anywhere. There is no bruit to be heard over the foot. However, a distinct systolic bruit can be heard in front of the ankle on a level with the malleoli, and just below the internal malleolus. The anterior tibial artery about 4 inches above the lower end of the tibia seems very large and pulsates forcibly. Compression of this artery causes the bruit in front of the ankle to disappear but apparently intensifies the one below the internal malleolus. A pulse can be felt in the region of the posterior tibial vessel, the compression of which converts the bruit into a shrill musical sound. Compression of this artery and of the anterior tibial vessel causes the disappearance of all bruits. The right popliteal artery does not appear to be any larger than the left one. When the patient stands up for a long time or at evening after she has been working all day, the toes of the right foot get rather cyanotic, especially the second toe. Blood pressure 164/100, Right leg; 132/90, left leg; 130/88, right arm.

This case illustrates the great difficulty of curing long-standing cirroid aneurysms, especially those of the hands and feet. The mass of extremely thin-walled, dilated and pulsating arteries and veins encourages the development of numerous communications. This is especially true in the old cases where the ramifications of these very abnormal vessels can be subjected to the trauma of joints. In the hands and feet the effect of the numerous joints on these vessels must produce fistulae

very easily. Even after the excision of all abnormal communications, it is entirely likely that new ones could easily be produced by the trauma of the joints upon the degenerated vessels that

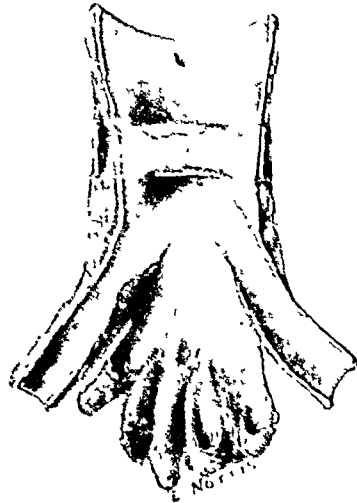


FIG. 14. Six months after the application of a markedly constricting band to a dog's aorta. The band has cut through, establishing a new lumen behind it.

were left. In the case reported, it seems that the communications in the foot proper have been eliminated but that new ones have occurred in the vessels about the astragalus. A direct attack on these communications will be difficult and, before doing this, further ligations of the dilated proximal arteries will be done. The enormous blood supply to the foot makes it apparently safe to ligate any number of large proximal arteries. Although we have already ligated the anterior tibial, the dorsalis pedis and the posterior tibial arteries, I believe the popliteal could also be ligated without danger of gangrene.

CASE IX. A small white boy, aged eight years, was admitted to the Children's Hospital, March 12, 1928, with an eye condition for which he had previously consulted Dr. D. T. Vail, Jr. In June 1927, or eight months previously, the child had injured his left eye by running a small piece of chicken wire into the eye ball. This puncture was apparently into the lower inner quadrant of the eye, although no scar of it could be detected. Six weeks after this injury the eye became reddish and he was treated for pink eye. By September the left eyelids, particularly the upper lid, were

noted to be swollen, and the conjunctival veins were very large and very red. Later the supraorbital vein became large and varicosities appeared in the eyelids and on the nose around the inner canthus of the eye. When he

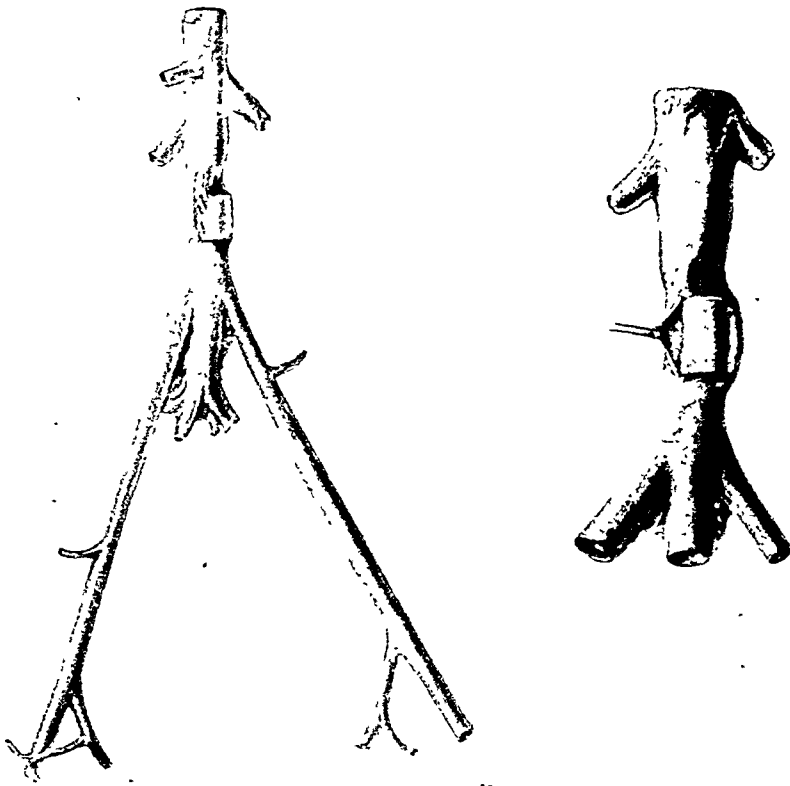


FIG. 15. Four months after the application of a band, tightened to the point of almost complete occlusion. The dog's aorta was completely occluded at the time of sacrificing him, but note that the band is practically extended from its original site.

was first seen by Dr. Vail, a few days before our operation, an aneurysm of the eye was detected. The conjunctival veins were very large and distended with arterial blood. They, as well as the larger varicosities of the eyelids, nose and forehead definitely pulsated. The eyeball protruded to a moderate degree and definitely pulsated. There was no edema such as is usually very marked when there is an intracranial arteriovenous fistula between the cavernous sinus and internal carotid artery. The retinal veins were distended and pulsated. Vision did not appear to be disturbed. On light palpation over the closed eye a faint thrill could be felt. A definite arterio-

venous bruit could be heard over the eye, nose and forehead. Temporary occlusion of the common carotid artery caused the eye to recede, the veins to collapse partially and to cease pulsating, the thrill and bruit to disappear. Not knowing exactly where the perforation had occurred and because the most marked signs of cirroid aneurysm were at the inner angle of the eye, I felt that the abnormal communications were probably between branches of the external carotid artery and the neighboring veins.

Operation, March 13, 1928. We first exposed the bifurcation of the common carotid artery. Here we were surprised to find that temporary occlusion of the external carotid artery had no effect on the aneurysm but that occlusion of the internal carotid completely stilled it. Consequently, the external carotid artery was permanently ligated with a heavy silk ligature and the common carotid was occluded by a removable aluminum band. Through a Kilian incision over the left tear sac and extending into the brow, the supraorbital and other large veins in the exposed area were excised. Another small incision in the upper eyelid allowed the removal of a large vein. All ligations were made with silk ligatures.

For five days after the operation, the patient vomited very frequently. On the third day a slight weakness of the right face and of the right arm was noted. This paralysis did not progress but disappeared entirely in about two weeks. We interpreted the vomiting, as well as the paralysis, as being due to cerebral anemia. During this period of uneasiness, it was a great comfort to know that we could remove the metallic band if the symptoms demanded it.

The patient has made a complete recovery and now shows no evidences of an aneurysm or of any cerebral disturbances. In this case the terminal branches of the ophthalmic artery were certainly involved in the anastomosis. There may have been only one abnormal arteriovenous communication, but, in any event, the clinical picture was typical of a cirroid aneurysm.

September 27, 1930. Examination of this patient reveals some interesting findings. The dilated conjunctival veins have almost completely disappeared. There is no exophthalmos. No enlarged veins in the eyelids, about the nose or on the forehead are seen. Auscultation over and about the eye reveals no bruit. There is no evidence of any right-sided weakness. Mental development appears to be normal.

In the neck, the left common carotid artery is about one-quarter as large as the right, and definitely pulsates. At the site of the occluding band, a loud harsh systolic bruit can be heard such as one can hear when an artery is markedly constricted. Four months after the original operation, the artery was totally occluded for I could not then detect either a murmur or a pulsation. Since that time and now, there has been a partial restoration of the lumen with a return of function in the artery.

This is a confirmation in the human of similar observations that Dr. Halsted and I frequently made when occluding the abdominal aorta of dogs with the metallic band. On the other hand a partially occluding band very frequently led to a complete occlusion of the vessel.

In dogs, we usually observed a dilatation of the artery distal to a partial occlusion of its lumen. As yet, no such effect is obvious in the case of this child. In the years to come we may have the chance to watch its development just as Halsted did in a remarkable case where he partially occluded the innominate artery.

EXPERIMENTAL AND CLINICAL BASIS FOR
ARTERECTOMY IN THE TREATMENT OF
LOCALIZED ARTERIAL OBLITERATIONS

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AS A RULE we consider only the mechanical interference with the circulation of blood which results from the localized arterial obliteration following ligation, arterial embolism or arteritis, since we are accustomed to regard the arteries as rubber tubes which carry the blood mechanically, and we too often forget that the arterial wall itself can influence the circulation of blood by way of its own nerves. Normally the arterial wall changes every instant and modifies the flow of blood by definite vasomotor reactions which are most marked in the arterial capillary system distal from the point of excitation. Vasomotor changes of a lesser degree also occur proximal to the point of excitation as well as generally throughout the entire vascular system. A large number of the nerves of the arteries are sensory in nature and by way of reflex action they control these peripheral vasomotor changes. Experimentally it has been shown that these nerves can be excited by changes in the chemical composition of the blood and by physical distention of the artery itself. I believe they play an important rôle in the normal and pathological physiology of the circulation of the blood. When an artery becomes obliterated these nerves do not remain intact but, on the contrary, are put into a stage of hyperexcitation by the trophic changes in the arterial wall and the organization of the blood clot which occurs at the site of the trauma or inflammation. This chronic hyperexcitation may give rise to vasomotor disturbances either of the vasoconstrictor or of the vasodilator type. I am of the impression that the cyanosis, pain, trophic disturbances, muscular hypotonia and, not infrequently, crises of the pseudo-Raynaud type that appear

after the obliteration of an artery are due to such reflex vasomotor reactions.¹ The signs and symptoms which appear after the obliteration of a large artery may be divided into two main classes: first, those due to the mechanical interference with the flow of blood causing intermittent claudication and, secondly, the cyanosis, pain, trophic disturbances and muscular hypotonia which result from the chronic excitation of the nerves in the arterial wall. The obliterated artery ceases to be an artery and becomes a diseased sympathetic nerve. The fact that these symptoms and signs disappear immediately after the resection of an obliterated artery that resulted from ligation is clinical proof that the obliterated artery acts as a diseased sympathetic nerve. The following case history is presented as a typical example of this type of disturbance.

On July 9, 1916, a soldier, wounded in battle, was admitted to the base hospital. An extensive wound of the upper arm necessitated the ligation of the brachial artery and brachial veins. The severed median nerve was sutured. The patient was again seen on November 15, because of complete loss of function of the hand. Examination showed that the motor paralysis was almost complete. The skin of the hand was cold and cyanotic. The radial pulse could not be felt on that side. The muscles of the arm could be excited by a galvanic current but not by a faradic current. A second operation was performed on November 18, 1916. The median and ulnar nerves were found to be embedded in dense scar tissue. Both nerves were carefully freed from the surrounding tissue and then each was encased in a separate fascial sheath. There was no improvement following this operation. On January 8, 1917 another operation was performed in which the brachial artery was isolated. It was found to be transformed into a fibrous cord throughout its entire length. A segment of the artery 12 cm. long was resected. The nerves were left undisturbed. The following morning the hand was very warm and the cyanosis had completely disappeared. The radial pulse was palpable but it was very feeble. The pain had completely disappeared and the patient was able to flex his fingers to approximately 90 degrees. There was a marked improvement in the general circulation of the hand and forearm as shown by the following comparative measurements:

A. Readings made before the second operation (neurolysis), Nov. 18, 1916.

	Normal side	Injured side
Systolic blood pressure	130 mm.	0 mm.
Ocillometric index (Pachon)	2	0

b. Readings made one week after the neurolysis, Nov. 25, 1916.

	Normal side	Injured side
Systolic blood pressure.....	135 mm.	0
Oscillometric index (Pachon).....	2	0
Arteriolar pressure (Gaertner).....	120 mm.	100 mm.

c. Readings made one day after the arterectomy, Jan. 9, 1917.

	Normal side	Injured side
Systolic blood pressure.....	100 mm.	65 mm.

d. Readings made five days after the arterectomy, Jan. 13, 1917.

	Normal side	Injured side
Systolic blood pressure.....	110 mm.	115 mm.
Oscillometric index (Pachon).....	2	1
Arteriolar pressure (Gaertner).....	120 mm.	120 mm.

e. Readings made thirty-five days after the arterectomy, Feb. 13, 1917.

	Normal side	Injured side
Systolic blood pressure.....	130 mm.	65 mm.
Oscillometric index (Pachon).....	3	$\frac{1}{2}$

The influence of arterectomy upon trophic ulcerations is equally striking and the following case has been selected as a typical example of the benefit that may be derived from this form of therapy.

A soldier, wounded in battle, was brought into the base hospital. Examination revealed a compound comminuted fracture of the lower leg and a deep, lacerated wound on the anterior aspect of the thigh. It was necessary to amputate the leg in the lower third and also ligate the superficial femoral artery. The immediate postoperative course was uneventful. The patient returned some weeks later because of trophic ulcers on the stump. The leg was re-amputated in the upper third. The wound healed by first intention but a short time later small ulcers appeared on either side of the scar. In spite of a negative history for syphilis intensive anti-luetic treatment was carried out but it produced no improvement in the ulcerations.

About eighteen months after the original injury I saw the patient for the first time. Examination showed the stump to be very edematous,

hyperesthetic and the distal portion was covered with eczema. The patient complained of constant throbbing pain in the entire stump. There were two ulcerated areas about 2.5 cm. in diameter near the end of the stump. The ulcers had grayish-green moist bases and were surrounded by dense scar tissue.

On May 4, 1922, I isolated the femoral artery and found that it had been transformed into a solid fibrous cord and was embedded in dense scar tissue. A segment of the artery about 8 cm. long was resected. The wound was closed tightly. By the next morning the pain and edema had completely disappeared. The stump was very warm and the eruption on the skin of the stump was less moist. The ulcers soon became dry and a crust appeared over them. On the fourth postoperative day one of the ulcers was completely epithelialized and two days later the other ulcer was also completely healed. The patient left the hospital twelve days after the operation with both ulcers completely healed, the eczema dry, the edema of the stump completely gone and without pain.

In 1917 six similar cases were reported by Heitz and myself.² In all of these cases an arterial obliteration produced definite peripheral vascular disturbances that were not due to the diminished flow of blood to the extremity. Without doubt, the edema, cyanosis, pain, subjective impression of cold and the trophic ulcerations were the result of a vasomotor reflex. The removal of the obliterated artery did not modify the circulation mechanically but by reflex action caused all of these signs and symptoms to disappear. For this reason I believe arterectomy should be considered as an operation upon the nervous system since in last analysis it is a very complete arterial sympathectomy.

In 1920 Halsted³ published the following interesting observation which strengthens the argument for the resection of an obliterated artery. On April 26, 1918 he performed a ligation of the left subclavian and axillary arteries because of a subclavian aneurysm. Following this operation the patient was greatly improved but his left hand remained cold and cyanotic. There was only a slight improvement in the circulation of the left hand and forearm during the following two years. At a second operation performed in 1920 the obliterated aneurysmal sac was excised. Halsted was greatly surprised

to find that, within six hours after the operation, the hand, which had been cold for more than two years, suddenly became very warm. Fifty-six days later the left hand and forearm were still warmer than the right. This is the same type of hyperemia that I have observed after the resection of an obliterated artery. The physiological changes which occur after arterectomy are due to the resection of the sympathetic nerve fibers in the wall of the artery and consequently are identical with the changes which occur after periarterial sympathectomy. For this reason I have emphasized for many years that resection of a small part of the artery should always be substituted for simple ligation. In my clinic since we have been doing a resection of a part of the artery in place of simple ligation we have had decidedly fewer cases of vasomotor disturbances in the extremities to deal with.

In order to determine if the same physiological changes could be reproduced in an experimental animal I asked two of my assistants, Dr. Stricker and Dr. Orban⁴ to carry out experiments concerning this problem. In five to nine successive stages they removed the following large arteries of the dog: the femorals, the anterior tibials, the posterior tibials, the inferior gluteals, the external iliacs, the hypogastrics, the brachials, the radials and the lateral sacral arteries (Fig. 1). At the final operation of each series the bifurcation of the aorta and the common iliac arteries were removed. The carotid arteries, the thoracic aorta and the abdominal aorta down to the origin of the inferior mesenteric artery were not removed.

Within a few hours after each operation the corresponding extremity became colder than the opposite member, but only rarely was there any visible edema of the extremity. After about thirty hours the extremity became warmer than the opposite side and as soon as this hyperemia was established the function of the extremity returned completely and the animal was able to walk about normally. This return of function did not always occur, however, after simple ligation of the artery. These dogs had practically no large arteries of the

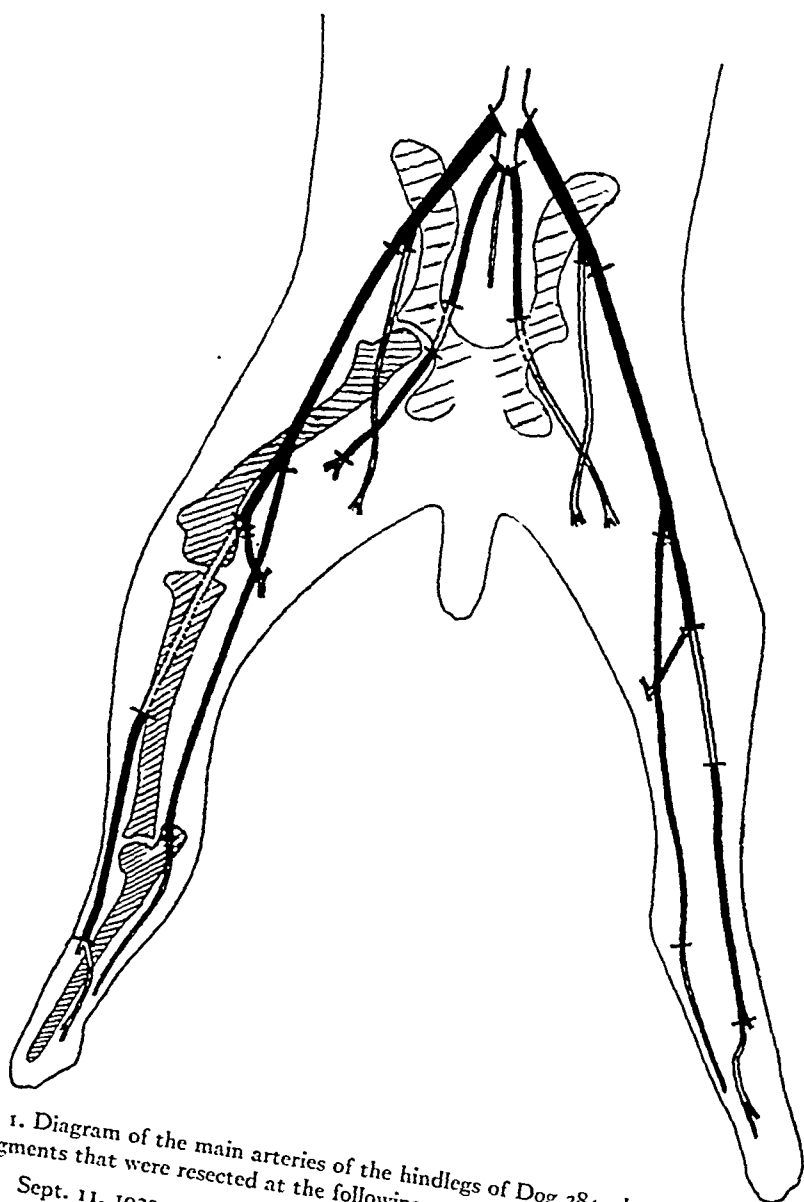


FIG. 1. Diagram of the main arteries of the hindlegs of Dog 284, showing, in black, the segments that were resected at the following operations:

Sept. 11, 1929. . .

Oct. 21, 1929.

Nov. 14, 1929

Jan. 27, 1930

Feb. 17, 1930

Following these operations the animal showed no evidence of trophic disturbances in the extremities. The animal was able to run and jump as well as a normal dog. On Feb. 2, 1930 she gave birth to four well-developed pups.

limbs yet within a week after the last operation of the series they were able to run around, stand on their hind legs and jump over obstacles with the same facility as normal dogs.

In another series of dogs we studied the comparative effect of ligation and resection of an artery. The artery was simply ligated on one side, while on the opposite side of the animal the corresponding artery was resected. Invariably the collateral circulation was completely established after approximately thirty hours on the side where the artery was resected while two to three days were required for the establishment of the collateral circulation on the side where the artery was ligated. In many of the dogs the collateral arterial circulation was studied by means of the x-ray after the injection of an opaque material into the entire arterial system (Fig. 2). In the animals in which the arteries were resected we were not able to demonstrate the newly formed network of collateral arteries which Luigi Porta⁵ called "anastomosis of collateral direct type," while after simple ligation this type of anastomosing arteries is always present. However, the collateral arteries were much more numerous after the resection of a large artery than after simple ligation of it.

Stricker and Orban⁴ then attempted to make a massive resection of the main arteries at one operation, removing the bifurcation of the aorta and both common iliac arteries at one time. All of the dogs subjected to this operation died within a few days after the operation with marked edema of the legs, loss of motor function of the legs, a decided drop in the temperature of both extremities associated with marked cyanosis. However, if both lumbar sympathetic chains were removed just prior to the resection of the bifurcation of the aorta and the common iliac arteries, the grave disturbances in the extremities did not occur and the animal was only slightly disturbed by the very extensive arterectomy. Twenty-four hours after the operation the hindlegs were slightly warmer than the forelegs and within six days the animals were able to run and jump without any discomfort or impairments of function of the



FIG. 2. Dog 265. Roentgenogram of the injected arterial system taken about eight months after all the large arteries of the extremities had been resected. Collateral arterial circulation was well established.

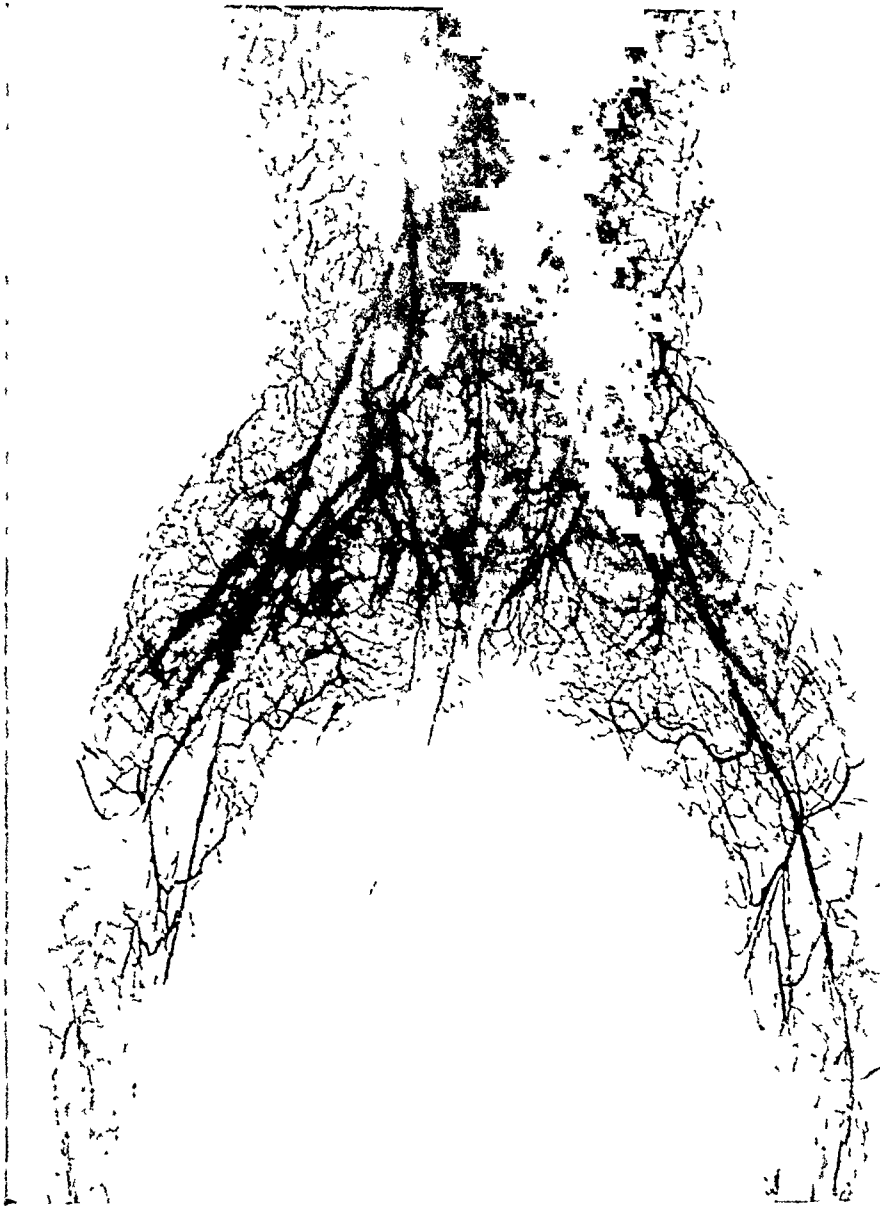


FIG. 3. Dog 347. Roentgenogram of the injected arterial system taken one month after the resection of the bifurcation of the aorta and both common iliac arteries. This extensive arterectomy was preceded by an extirpation of both lumbar sympathetic chains.

legs. No trophic ulcerations have ever appeared on any of the animals of this group, even though some of the animals were allowed to lead an active life for more than four months. The collateral arterial circulation was shown to be well established by the roentgenograms of the extremities taken after the arterial system had been filled with a liquid that was opaque to the x-rays (Fig. 3).

These experimental studies show the important rôle played by the lumbar sympathetic nerves and the nerves of the arteries in the regulation of the peripheral circulation. They help us to understand the part played by these nerves in the vascular disturbances that follow arterial obliteration and justify the resection of the obliterated artery in all such cases.

Since 1916 I⁶ have performed many arterectomies for arterial obliteration following ligation, trauma, acute thrombosis, arteritis due to frostbite, emboli (which were too late for embolectomy), localized arteritis and recent thrombosis in arteriosclerosis. Usually there was a great improvement in the circulation following the arterectomy but occasionally the procedure failed to give even the slightest improvement. The best results were obtained in those cases in which it was technically possible to remove the entire obliterated portion of the artery leaving unobstructed artery above and below the resected area. Arterectomy is, consequently, of little value in true thromboangiitis obliterans (Buerger's disease) since the obliteration of the arteries is far too extensive to permit complete removal.

The great majority of my cases have already been published⁷ but for the purpose of illustration I would like to present the following two case histories as typical examples of the beneficial results following arterectomy for localized arterial obliteration.

CASE 1. A printer, aged fifty-six years, entered the hospital because of severe pain in his left arm of about three weeks' duration. He had always been in good health. No history of diabetes, heart disease or infectious diseases. He denied syphilis. Blood pressure was normal. Blood Wassermann

reaction was negative. His present illness began on September 2, 1928. While at work he felt a sudden, severe, sharp pain in his left forearm. His left hand became cold and he was unable to move his fingers. The

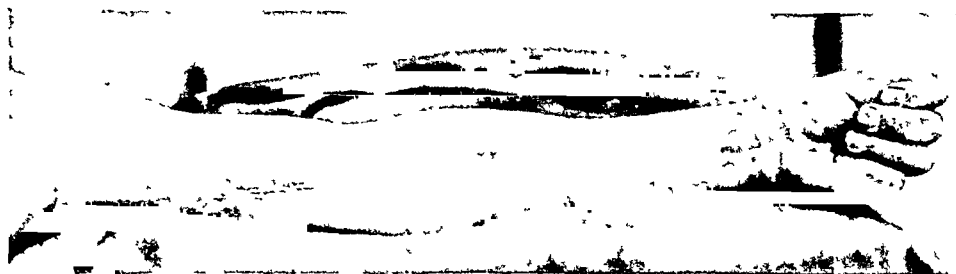


FIG. 4. Photograph taken several weeks after the resection of the obliterated brachial artery. Note the ability of the patient to close his fist tightly.

pain remained about the same until he immersed his arm and hand into hot water. Within a few minutes the pain disappeared and he was able to move his fingers. The subjective sensation of cold in his left hand remained unaltered by the hot water. About seventeen hours later the same phenomena recurred but this time the pain and the loss of function of the fingers was not influenced by the hot-water bath. For weeks there was no improvement, then gradually the pain in the hand and forearm became less severe and there was a partial return of motion of the fingers and wrist. There was no palpable pulsation in the brachial artery and there was an absence of oscillations by the Pachon oscillometer.

On September 25, 1928 the brachial artery was exposed at operation and found to be obliterated by a red clot which extended from the lower third of the artery through the bifurcation and into the radial and ulnar arteries. These arteries were also obliterated. Seven centimeters of the brachial artery including the bifurcation were removed. The wound healed by primary intention (Fig. 4).

Histologically the arterial lumen was completely obliterated. About four-fifths of the obliteration was due to a recent clot of fibrin while one-fifth was due to an old thickening of the intima of the artery. There was no evidence of any inflammatory reaction in the wall of the artery. Cultures of a piece of the arterial wall showed no growth of bacteria.

The next morning the left hand was very warm, the pain had disappeared completely and there was a marked improvement in the motion of all the fingers. There were slight oscillations produced in the Pachon oscillometer. The patient was discharged from the hospital nine days after the operation. Two weeks later he returned to his work as a printer. He stated that within three weeks after the operation he was unable to detect any difference between his two hands. He has been seen at regular

intervals since the operation and there has been no return of his former symptoms. In April 1930, about nineteen months after the operation, he was examined and his left hand was found to be slightly colder than the right. The strength, however, remained very good. Dynamometer tests showed a reading of 40 kilograms for each hand. Except for very fine movements of the thumb and index finger of the left hand the motion of the fingers was excellent. No pulsations could be felt in either the brachial or the radial artery of the left arm. Only very slight oscillations were produced in the Pachon oscillometer when the cuff was applied to the left arm. The arteriolar pressure as measured by the Gaertner instrument varied from 40 to 60 mm. on the left and from 100 to 110 mm. on the right side. There was no evidence of any other circulatory disturbance in the extremity.

CASE II. A forty-six year old school-teacher was referred into the hospital because of vasomotor disturbances in the right arm and hand. Her present illness began in about 1911 with marked weakness of her right hand especially after slight exertion. The entire right hand and forearm became red and the superficial veins became very prominent when her arm was put in the dependent position. Gradually the condition grew worse and soon the entire arm became cyanotic on slight exposure to cold. These vasomotor disturbances were associated with severe cramp-like pains. The pains were at first limited to the right hand but later began to extend over the entire forearm and up to the shoulder. If the exposure to cold was continued the cyanosis of the hand would be replaced by a marked blanching which usually started on the fourth finger. Within the last few years the crises had become increasingly more frequent and extremely painful, and during the last few months had become so frequent at night that the patient had been unable to get any rest. On examination there was marked hypotonia and loss of strength of the muscles of the arms. During the examination the patient had one of these crises which I observed personally. It was a typical crisis of Raynaud's disease. There was also marked hyperkeratinization of the thumb nail as is frequently seen in Raynaud's disease. After the crisis all the movements of the hand and fingers were normal but the patient complained of complete loss of strength. She gave a history of intermittent claudication of both arms. She added that when she attempted to write on the blackboard in school her arm would become fatigued quickly and would fall to her side. The oscillometric index was only $\frac{1}{4}$ on the right side and seven on the left side. There was no pulsation of the subclavian artery palpable in the supraclavicular fossa. There was an old pseudo-arthritis of the clavicle which was unknown to the patient and which probably dates back to her childhood.

On February 12, 1921 I isolated the subclavian artery and found it was completely obliterated. I resected the artery from the clavicle to a point between the scaleni muscles. Following the operation the crises disappeared and there was a general improvement in the circulation of the arm. One month after the operation she was able to write with her right hand. She, however, never gained sufficient strength in that hand to permit her to do hard work. Histological examination of the resected segment showed the lumen to be completely filled with a partially organized clot. There has been a very slow but constant improvement in the circulation of the right arm. At the present time she is very well. She has had no pain in her arm since the operation. During the winter, however, prolonged exposure to cold causes moderate cyanosis of the forearm and hand but entirely without pain.

It is interesting that in this case a typical Raynaud's syndrome was produced by a localized obliteration of the subclavian artery. These severe painful crises have completely disappeared since the resection of the obliterated subclavian artery which was done over nine years ago.

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RAYNAUD'S DISEASE AND THROMBOANGIITIC GANGRENE

OF THE UPPER EXTREMITIES TREATED BY RESECTION OF THE
SYMPATHETIC GANGLIA AND TRUNK

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TREATMENT of gangrene of the limbs has recently reached greater surgical importance, owing to new diagnostic and therapeutic principles.

As Dr. Matas is one of the most prominent modern contributors to the treatment of diseases of the blood vessels and of lesions resulting from circulatory troubles, so for his Jubilee I have chosen to report the results of my personal experience in some cases of this kind of lesion.

In a consideration of embolic gangrenes one can easily realize what great progress has been accomplished in diagnosis and surgical treatment. Since the first imperfect endeavors (Ssabanejeff, 1895) what a long and difficult way to the modern early and technically perfect operations which are often followed by long-standing cures!

What we need is a more close and ready collaboration between surgeons and internists. These must be convinced that only surgery can save the limb and often the patient's life when a peripheral artery is closed by the impaction of an embolus. As an early diagnosis is not difficult, surgeons ought to be called to operate as soon as possible; so the successes will increase and I dare say that nearly every case will be cured. What can be obtained in this line is shown by the many successful cases reported especially by Scandinavian surgeons (E. Key,¹ Wideröes, Lindström). Also the bold Trendelenburg operation for removal of emboli from the pulmonary artery has reached its goal (Krüger, Kirschner, Mayer, Nyström²).

But in these cases the pathogenesis of the gangrene is clear enough and in consequence treatment is well defined. There

are, however, other varieties of gangrene whose predisposing and exciting conditions are not well known at all. I mean those in which obstruction of blood vessels is not to be found, or this is only secondary and diffuse.

An instance of the first class of lesions, which can also in severe cases cause gangrene, is the clinical syndrome known as Raynaud's disease (1862). Its fundamental features are vasomotor troubles of spastic character, usually affecting fingers or toes, which cause paroxysmal attacks of anemia, followed by cyanosis, with numbness or anesthesia and intense pain. Superficial sloughs or gangrene of the fingers or toes may follow. These lesions are usually symmetrical, but can prevail on one side, and are more frequent in women than in men. One item of capital importance in diagnosis is the presence of pulse in the peripheral arteries (pedis, tibialis posterior, radialis, ulnaris). Investigation of capillary circulation can give important data. Brown has advised the so-called "vasomotor or vascular index." This can be obtained by bringing forth in the patient a rise of temperature by intravenous injection of proteins (for instance, typhoid vaccine) and ascertaining the difference between the rise of local cutaneous and that of buccal or blood temperature. This "index" which in arteriosclerosis is always very low (often = 0), and can reach rather high figures (2-6) in cases of thromboangiitis obliterans, is always high in typical cases of Raynaud's disease. It is understood, therefore, that, excepting in those mild cases which yield to medical treatment, an attempt has been made to use our knowledge of the inner nature of the disease to get a cure, by severing the vasomotor pathways. The first operations of this kind were, as is well known, periarterial sympathectomies, which performed for the first time by Jaboulay, were afterwards especially extended and widely applied by Leriche³ and other surgeons. The different results caused neurologists and surgeons to interfere more centrally with the vasomotor pathways, and to sever the rami communicantes, or to resect the ganglia or the sympathetic

trunk in its lumbar or cervico-thoracic segment according to the site of the lesion.

Diez was the first (1924)⁴ to operate on the lumbar and sacral ganglia in a case of Raynaud's disease, followed by Adson and Brown (1925).⁵ The latter did not know anything of Diez's operation; they were led to perform such an operation, after they had noted a remarkable vasodilation following ramisectomies or ganglionectomies of the lumbar sympathetic trunk in cases of spastic paralysis. Royle had also pointed out the same thing.

But I wish to limit myself to the cervico-thoracic ganglionectomy, which is the operation that I have performed. It is well known that the removal of the cervical sympathetic trunk, with or without the lower ganglion, has been done in cases of epilepsy, exophthalmic goiter, glaucoma and more recently in cases of angina pectoris by Jonnesco⁶ and others. In cases of vasomotor troubles of the upper limbs (Raynaud's disease, scleroderma) Brüning (1923)⁷ resected the lower cervical and first thoracic ganglia by an anterior route. Following Brüning's technique, Diez has also removed the middle cervical and the cervico-thoracic ganglia for thromboangiitic gangrene in two cases. Davis and Kanavel (1924),⁸ in a case of Raynaud's disease of the upper limb, removed thoroughly the cervical sympathetic trunk with its three ganglia. Royle (1927)⁹ and Fulton (1928)¹⁰ reported on ramisectomies for Raynaud's disease and thromboangiitic gangrene. Later Royle with a more perfected technique (1928)¹¹ (section of the clavicular attachment of the sterno-cleido-mastoideus and division of the tendon of the scalenus anticus) succeeded in severing the sympathetic trunk below the cervico-thoracic ganglion.

But Kuntz before and Brown afterwards had pointed out that the second thoracic ganglion also sends fibers to the brachial plexus through the second thoracic nerve, which very often supplies fibers to the lower trunk of the brachial plexus. Working with Adson, Brown thought, following a route proposed by Henry (1924), of reaching the sympathetic from

behind, to remove in this way the cervico-thoracic and the second thoracic ganglia together with the intervening chain, so as to sever thoroughly the sympathetic fibers to the upper limb.

With this technique Adson operated on his first patient on both sides in 1928. In 1929 Adson and Brown reported on two other cases.¹² I will not deal with the technique as it is reported with ample detail in Adson's papers. I have somewhat modified it in my cases, because I have resected not only the transverse apophysis of the second, but also that of the first thoracic vertebra. I do not think that this complicates the operation or makes it more severe, instead it makes easier the removal of the stellate ganglion, the division of its several rami communicantes and of the sympathetic trunk above.

The first patient I operated on, with the technique I have spoken of, was a case of thromboangiitic gangrene and the operation was performed on both sides.

In Raynaud's disease and, generally speaking, in all vasomotor troubles of the limbs (Weir-Mitchell's erythromelalgia, scleroderma and so on) such operations seem fully justified by what we think the nature of the disease. In thromboangiitis obliterans this could not seem to be the case. Really we are very far from having clear ideas on the so-called juvenile gangrene. The cases which Winiwarter¹⁴ reported in 1879 of primary non-syphilitic, non-arteriosclerotic lesions of the vessel walls have been variously explained. Those reported by Leo Bürger¹⁵ although not clearly understood in their pathogenesis doubtless belong to the same type of disease. They occurred nearly always in men; they caused at last diffuse vasal obstruction, this feature making them quite different from those of Raynaud's disease, with simply spastic closure of arteries, but in some cases they showed symptoms very similar to those of this disease. This is so true, that several cases reported as Raynaud's disease turned out afterwards, on a more close examination, to be really typical thromboangiitic gangrene. Allen and Brown

think that the greater number of cases of so-called Raynaud's disease in men are more probably cases of L. Bürger's gangrene.

We may state that the anatomical features of this type of gangrene are well defined. I have had occasion of studying several cases of it, specimens for microscopical examination having sometimes been taken from superficial veins, and I have always found the lesions described by L. Bürger. But of their inner nature and pathogenesis, our ideas are far from being clear and certain. It is quite natural, that the leading principles of a proper treatment should also be uncertain. Bürger holds the disease as due to widespread inflammation of the vessels of a limb. The inflammation would be caused by an infective process favored by toxic and discrasic factors. An early diagnosis would therefore be necessary in an endeavor for a successful treatment, to avoid a widespread thrombosis. But this is not possible as we lack the proper treatment, and above all because generally we see patients in advanced degrees of progress of disease, complaining of actual gangrene. Thrombosed vessels can, though slowly, be made pervious again by organization and vascularization of thrombi. We can therefore endeavor to stop the progress of the disease by favoring the circulatory conditions of the limb, removing any spastic vasomotor stimulus which can be present, and we know they are present, and bringing forth a vasodilation. Sometimes these measures are able to reestablish a supply of blood sufficient for the life of the tissues.

Oppel on the contrary, and others, believe that the disease is brought forth by spastic contraction of the arteries, supported by a condition of hyperadrenalinemia. On this basis Oppel and other Russian surgeons, Leriche in France, and Donati, Serafini, Pieri in Italy, have removed the left suprarenal body to counteract that supposed predisposing condition of the disease.

We must recognize that these theories have never been proved, and really many authors do not agree with them. We must acknowledge also that the reported operated cases do not appear as striking successes.

In a previous series of seven cases of thromboangiitis obliterans, reported by my assistant Dr. Ghiron, in which I performed a periarterial sympathectomy, I have not had a single cure.

I have no personal experience with ligature of veins, or with arteriovenous anastomosis, or with operations upon the nerves of the limb, or with removal of the left suprarenal body. Anyway from the cases reported by other surgeons I think it right to infer, that in no instance has such an operation led to a permanent cure. Pains have subsided, perhaps the circulation of the limb has improved, but only for a short while.

For these reasons I did not choose any one of the aforesaid operations in an especially severe case, which I reported¹⁸ before the Royal Academy of Medicine of Rome in March 1930. This man had undergone an amputation of both lower limbs, and complained of pains in both upper limbs, where limited, but obvious patches of gangrene were to be seen on the right side. I performed a cervico-thoracic ganglionectomy at first on this side and afterwards also on the left. As I have already pointed out, I believe this kind of operation to be especially useful when lesions are still in an early stage, it puts an end to pain and spasm and improves the circulation in the vessels which still keep an open lumen. A sufficient supply of blood to the peripheral structures is so reestablished, so that if other vessel fields are obstructed by the thromboangiitic process, the organization and vascularization of the thrombosed vessels can take a part in settling a sufficient circulatory balance, to support the vital processes of tissues.

The following are the clinical histories of my two cases:

CASE 1. M. G. aged thirty-five years, from Terni.

Previous History: Irrelevant, denies any venereal infection and syphilis. No use of alcohol or tobacco. Married; his wife has had seven sons, of whom one died when four years old, and no miscarriages.

Present Illness: Fifteen years ago while in the trenches as a soldier in war time, he began to complain of pains, cramps and numbness in both his feet and legs. He considered these troubles as due to the cold weather and noticed that they increased with exercise. Dismissed from the army he

resumed his work, but his troubles persisted with short periods of well being.

Four years ago he noticed a small ulcer on his right great toe, which gradually enlarged. Admitted to the Hospital of Terni he underwent an amputation of the great toe. The wound did not heal and the gangrenous process spread to the foot and reached the leg, so that an amputation of the thigh on its middle third was performed.

During this time he had noticed that both his upper limbs, but especially the right one, easily became ischemic if exposed to cold. He was discharged as cured from the hospital and did well till April 1928. At this time he was operated on for what the patient calls an ingrowing toenail: the operation was followed by a gangrenous process spreading to the foot and accompanied by continuous pains. In this condition he was admitted for the first time to my Clinic, April 22, 1928.

Physical examination showed: feeble pulse on the femoral artery, on the stump of the right thigh. On the left foot the loss of the great toe and a deep ulcer on its stump was to be seen. The bottom was formed by the head of the first metatarsal bone, covered by necrotic tissues. The lesion and neighboring skin were very painful. A very painful fissure was present on the sole of the foot.

Loss of pulse on the dorsalis pedis and popliteal artery, very feeble on the femoral artery in Scarpa's triangle. Wasting of the whole limb, whose skin was dry and cold.

Clinical Diagnosis: Thromboangiitis obliterans.

Operation: June 12, 1928. Amputation of the left leg at its middle third. The wound healed per primam and pain subsided.

Histologic examination of the vessels of the removed limb showed inflammatory changes of the vessel walls, typical of a thromboangiitic process.

Course: The patient was discharged on July. With an artificial limb and a crutch he was able to go around.

After a short while he began to complain of cramps and pains in his right hand. At the same time he suffered with a phlebitis of the superficial veins of his two stumps and of right forearm. The acute process subsided and the veins were changed into hard, non-painful cords.

Five months ago, a superficial bruise left behind an ulcer above the metacarpo-phalangeal joint of the right middle finger. The lesion was very painful and so were the arm and forearm.

Admitted again to the Clinic: November 16, 1929.

Physical Examination: A feeble pulse could be felt on both femoral arteries in Scarpa's triangle. Stumps were in good condition. There was wasting of the right upper limb. The aforesaid ulcer with a necrotic bottom did not reach the bone. There were edema of the whole hand; cyanosis of

the tips of the fingers. The skin felt very cold. Movements were greatly hindered by pain. Sensibility was preserved. There was loss of pulse on the radial and humeral arteries of the right side and of the radial on the left, weak pulse on the left humeral artery.

Oscillometry (Pachon). Only the left humeral artery gives small oscillations, 3 mm. wide. Mx = 95. Mn. cannot be measured.

Capillaroscopy. Right side: very few, partially empty capillaries.

Left side: capillaries in somewhat greater number, very pale.

A piece of the right cephalic vein was excised. The vein looked like a fibrous cord with a very narrow lumen. On microscopic examination the walls appeared very thickened owing to the presence of connective tissue and leucocytes in the tunica media and adventitia. No thrombosis.

While in the Clinic a complete paralysis of the left musculospiral and ulnar nerves supervened. The ulcer on the right hand deepened to the bone and patches of dry gangrene appeared also on the left hand.

Operation: January 21, 1930. Ether. Prof. Alessandri.

Skin incision from the spinous process of the fourth cervical vertebra to that of the eighth dorsal, somewhat to the right side of the median line. After the muscles had been retracted, the right side of the spinous process, the laminae, the transverse process and the first portion of the ribs from the first to the fourth rib were exposed from the first to the fourth dorsal vertebra. The transverse process of the second dorsal vertebra is cut through with a chisel and the loosened bone is separated from the corresponding rib. The pleura was then loosened with the finger from the thoracic fascia, and the rib was severed just outside of its articular surface for the transverse process, and the loosened fragment removed. The second thoracic ganglion, its rami communicantes and the intercostal vessels and nerve of the first space were at once exposed. The sympathetic trunk was severed below the ganglion and the rami communicantes were cut through. The transverse process of the first dorsal vertebra and the first rib were resected as the second; in this way the cervico-thoracic ganglion and a piece of the cervical thoracic trunk could be removed together with the second thoracic ganglion and the intervening trunk.

Postoperative Course: The wound healed uneventfully.

In the days following, the patient presented a Bernard-Hörner's syndrome, loss of pain and the whole upper limb was warmer than before and also than the left one. Around the gangrenous patches an area of inflammation was now to be seen.

Capillaroscopy showed no differences. In a fortnight a weak pulse on the right radial artery could be felt and a line of separation between the living and dead tissues was clearly established. After six weeks the necrotic parts had dropped off and left behind a healthy granulating zone.

At this time a dry gangrene of the left middle, ring and little finger appeared. The hand was swollen, cyanotic and painful.

Operation: April 4, 1930. (M.A.S.S. and local anesthesia). Prof. Allesandri. Removal of the left cervico-thoracic and first thoracic ganglia with the technique outlined previously.

Postoperative Course: The patient suffered a postoperative broncho-pneumonia which subsided in one week. A Bernard-Hörner's syndrome appeared also on the left side. The limb was much warmer than before. Pains and edema disappeared. The gangrenous parts separated and dropped off. In such fairly good condition the patient was discharged from the Clinic.

I saw him again on July 30, 1930.

He complained of no more pain or circulatory trouble in his upper limbs. The finger stumps are now covered with well-nourished skin. The pulse could be felt on both humeral arteries; it could not be felt on the radial arteries.

Oscillometry: Left arm: Mx = 120 (2 mm.), Mn = 80 (5 mm.).

Right arm: Mx = 110 (2 mm.), Mn = 45 (1 mm.).

No movements on the forearms.

CASE II. B. E., housewife from Rome, aged thirty-five years.

Previous History: Irrelevant. Married when twenty-seven years old, has had one son. No miscarriages. Has always complained of cold extremities in winter time. Two years ago noticed that both hands became extremely pale and soon afterwards of a bluish hue when exposed to cold, and were numb and painful. Lately necrotic patches had appeared on her finger tips, which had dropped off and left behind a granulating zone. Admitted to the Clinic: April 28, 1930.

Physical Examination: both index, middle and ring finger showed a cyanotic color with pale spots. Stellate scars are to be seen on the tip of the left middle and right middle and ring fingers. On the right index finger there was a whitlow covered with thickened skin.

When cooled with ether the cyanotic color spread to the whole hand, when warmed with a hot-water bag cyanosis changed into a pale color. The skin felt cold and damp.

Arterial pressure: left humeral artery: 110-70.

right humeral artery: 110-65.

right forearm: 90-80.

left forearm: 90-80.

Oscillations are wider on the left side. Increase of venous pressure on both sides.

Capillaroscopy shows the typical changes of vasoneurosis.

Basal metabolism: 25 per cent.

Suprarenin rate in blood: inferior to normal.

Operation: Prof. Alessandri, May 29, 1930.

Ether. Skin incision one inch to the left of the median line, from the spinous process of the fourth cervical vertebra to that of the fifth dorsal. Resection of the left transverse process of the first and second dorsal vertebrae and of one inch of the corresponding ribs. Removal of the second thoracic and cervico-thoracic ganglia; rami communicantes and sympathetic trunk above and below severed. The second intercostal artery tied and the second intercostal nerve cut through. A small opening of the pleura was easily closed.

Postoperative Course: As soon as the operation was completed a Bernard-Hörner's syndrome appeared. Both hands were warmer and of normal color, but the left one was distinctly warmer.

Pressure on left forearm: 140-80, wide oscillations.

Pressure on right forearm: 90-70.

After a couple of days the temperature of the skin of the hands fell to normal. Oscillations on the left forearm were less wide.

After one week oscillations were as before the operation, but temperature was normal and the pains had disappeared.

The patient was discharged one month after the operation in good condition, complaining of no trouble whatsoever.

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PERSONAL EXPERIENCE IN VASCULAR SURGERY

HUBERT A. ROYSTER, A.B., M.D., F.A.C.S.

RALEIGH, N. C.

THIRTY-FOUR years ago a young man just entering upon the practice of medicine reported the results of some observations which had interested him at the end of his first year's work. A reprint of the paper containing this report was sent by the young man to a surgeon eleven years his senior, already established in practice, and even then known as an advanced thinker and original investigator in medical subjects. Shortly afterwards (October 17, 1896) from the elder to the younger came a postcard on which was written in his fine characteristic chirography: "I have just returned from my vacation and found your valued paper . . . on my desk, awaiting acknowledgment. I thank you very much for your kind remembrance and I am much pleased to note that your experience confirms my own impressions on the subject." (Fig. 1.) Imagine, if you can, the joy implanted in the heart of the younger man who received and still cherishes this missive, and estimate, if you will, the depths of ambition stirred in him by this personal attention from the elder man, whose example and precept have furnished everlasting inspiration. From this auspicious beginning of an acquaintance by correspondence through its continuance in many delightful friendly meetings up to the present occasion when the elder man is to be honored in this volume and the younger man is permitted to pay his tribute, there has been no wavering of friendship, no fading of admiration on the part of the junior toward the senior, who cemented the bond by his gracious act of 1896. Need it be said that the elder and leading character in this narrative is none other than Rudolph Matas, master surgeon, and that the younger and grateful participant is the writer of this article?

My experience in surgery of the blood vessels has not been large, but it has extended over a period which included the older procedures, the newer conceptions and the ever-advanc-

17. 10. 96

My dear Doctor, I have just returned from my vacation
 I found your valued paper ~~in my~~ on my
 desk, awaiting acknowledgment. I thank you
 very much for your kind remembrance &
 have much pleasure to note that your
 experience confirms my own in the
 subject. Very sincerely Yours R.M.
 2255 St. Charles Ave N.O. La

FIG. 1. Facsimile of postcard received from Rudolph Matas, October 17, 1896.

ing changes still in order. With particular exceptions this experience has been limited to the treatment of aneurysms. In the early years by the older methods of ligation, I performed six operations: one each on the external and the common carotids, two for femoral and two for popliteal aneurysms. The carotid cases were cured; one femoral relapsed, the patient dying later of another disease; in one of the popliteal cases (a Hunterian ligation) there occurred a sloughing of the skin in the thigh, which continued for two months after the operation, but finally cleared up with proper healing. The second ligation in Hunter's canal effected a permanent recovery. Later on an enormous popliteal aneurysm, in which no ligation was attempted, required amputation in the lower third of the

thigh on account of an already septic sac with necrosis of the femur and infection of the knee-joint. This patient had a fatal stroke of apoplexy seven months after operation. Still another primary amputation had to be done for a large popliteal aneurysm into which a trocar previously had been plunged, producing hemorrhage and infection.

The result of the ligations in these six cases on the whole were as satisfactory as the reports of other surgeons at that time by the prevailing methods. The last of these operations was performed in 1905. All during this period every surgeon called upon to treat patients with aneurysm recognized the need for improved methods and longed for better results. Always there was fear of failure to cure, of gangrene, of recurrence, of complicating factors.

Not until Rudolph Matas devised his procedure of endo-aneurysmorrhaphy did the light of day begin to shine in this wide field. To him belongs the whole credit for conceiving, proposing and executing the most successful treatment for aneurysm so far known. He hit upon the plan in 1888 and first published it in the *Transactions of the American Surgical Association* for 1902.

The older methods had been considered good enough until they were superseded in 1785 by John Hunter's ligation at a distance from the sac. In like manner one hundred years later Hunter's method was cast in the background by that of Matas. In each instance there is an illustration of the trite situation that, when an easy way has been marked out of a difficulty, the question always arises: Why did not some one think of it before?

Though the Hunterian plan in its time was far superior to ligation near the sac proposed by Anel seventy-five years before, and, though it had the vogue of a century, it possesses certain disadvantages which had been evident long before its followers admitted them. Chief among these disadvantages is the danger of gangrene. Other objections are the high percentage of relapses and persistent enlargement of the sac.

HUBERT A. ROYSTER

Hunter desired to tie the artery far away from the aneurysm because of the fear of degenerative changes in the arterial coats near the sac and of the risk of infecting the sac while

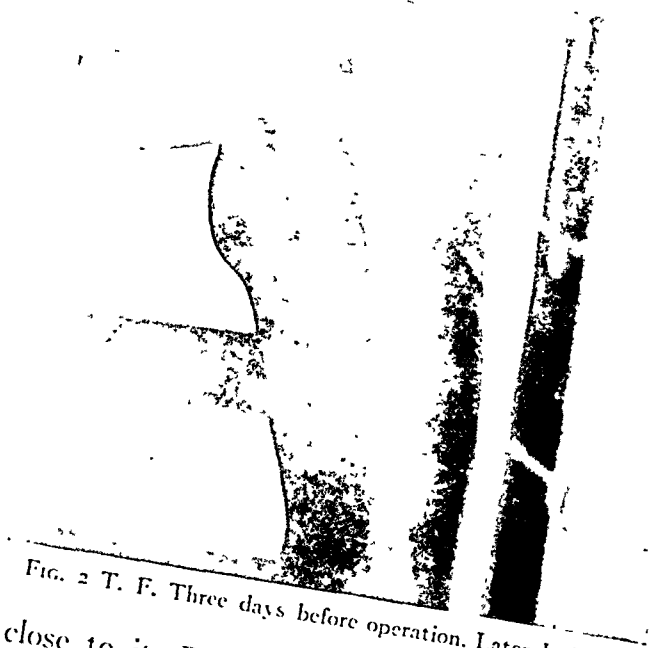


FIG. 2 T. F. Three days before operation. Lateral view.

working close to it. Precautions of this sort are, of course, groundless in the present day of aseptic surgery. The Anel method of ligating on the proximal side as near as possible to the sac is to be preferred to any other method of ligation (Matas).

It would be out of place in this volume to refer to the steps by which Professor Matas arrived at his epochal contribution, or to attempt any description of the technique now so widely known over the whole surgical world. I do wish, however, to put upon record here some notes of the very first operation by the Matas method I ever performed:

CASE I. James P., aged thirty-eight, butcher. Syphilis twenty years before. In April, 1912, he noticed a swelling back of his left knee. It had been getting gradually larger; he could not attend to his work. Examination showed a pulsating mass in the left popliteal space, with signs so definite as to leave no doubt of the diagnosis. The swelling was 4 inches in its longest diameter. The operation was performed August 5, 1912. With the patient lying face downward, a tourniquet was placed around the thigh at the apex of Scarpa's triangle and a liberal incision made over the middle of the aneurysm in the long axis of the leg. After exposing and opening the sac and removing the clots, the main openings of the vessel above and below were closed with one row of interrupted chromic gut sutures, then another row of continuous sutures of the same material was used, going all down the length of the sac, and finally a third row on top of these until the walls were quite approximated. By the sutures the several small openings in the sac wall were closed. The edges were brought together with silkworm gut stitches, each one taking bites in the sac so as to fold it upon itself and against the skin. In spite of great care the popliteal nerve must have been injured, for the patient had "drop foot" for several weeks after the operation. This complication, however, soon disappeared, and finally there was no evidence of the disability. The subsequent course of the patient's recovery was without interruption. He remains well to the present day.

The second operation by the same method was done a little over a year later. The report follows:

CASE II. Theodore F., forty years of age, carpenter. The patient had gonorrhea at seventeen and syphilis at twenty-two. Every spring he had rheumatism. About four years ago he first found a small knot in the left popliteal space. This continued to grow larger, becoming more painful as the size increased. For twelve months before admission to the hospital he was not able to work, and was barely able to walk on account of marked flexion at the knee joint. The swelling in this case was exceedingly large, 18 inches in circumference, and was indistinctly fluctuating, but there was absolutely no sign of pulsation. The knee joint was distended with fluid and the patella floated. The condition might easily be confused with a popliteal bursitis. This diagnosis, in fact, was originally considered. The accompanying photograph (Fig. 2) gives a fair idea of the appearance. The operation was done on December 6, 1913, in the same fashion as in the previous case. There were only two orifices in the aneurysmal cavity, the main openings of the artery. These were close together and near the surface, so that I inadvertently cut through the lower one of them when I incised the sac. But it was easily sutured and the operation

proceeded as usual according to the obliterative technique. This patient was discharged in good condition, with a healed wound and almost perfect extension of the leg. He had some numbness of the foot for ten days follow-

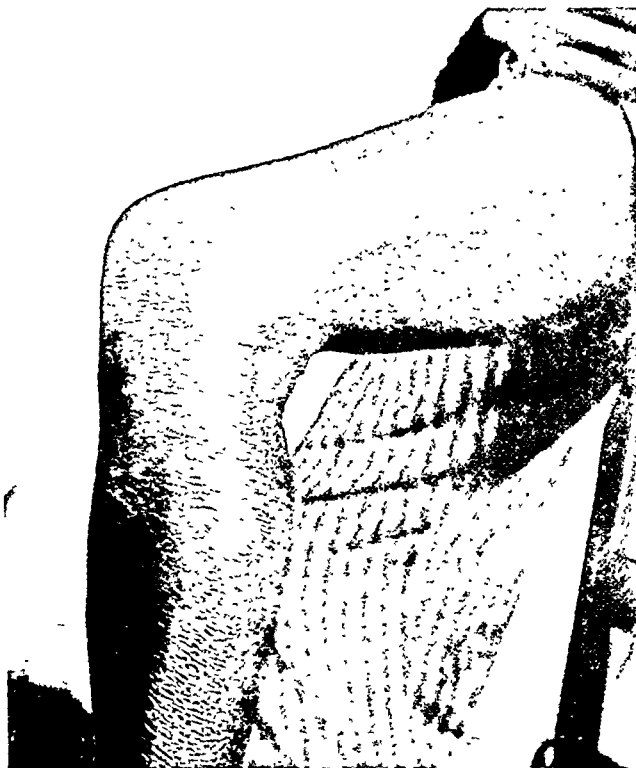


FIG. 3. T. F. Two months after operation. Lateral view.

ing the operation, but it gradually decreased and the circulation was always adequate. Photographs (Figs. 3 and 4) taken two months after operation indicate the improvement.

The earlier case was included by Doctor Matas in his paper read before the International Congress of Medicine at London, August, 1913. They were both published by me.¹

Two unusual cases very recently published² represent my further experience with the Matas method. These will not be reviewed here, but merely noted by title and illustrations.

¹ *Old Dominion J. Med. & Surg.*, 18: 4 (April) 1914.

² *Surg. Clin. North America*, 10: Number 4 (August) 1930.

They were: 1. Aneurysm of the Brachial Artery; Reconstructive Endoaneurysmorrhaphy (Figs. 5 and 6). 2. Huge Aneurysm of the Sciatic Artery Resembling a Sarcoma of the Buttock

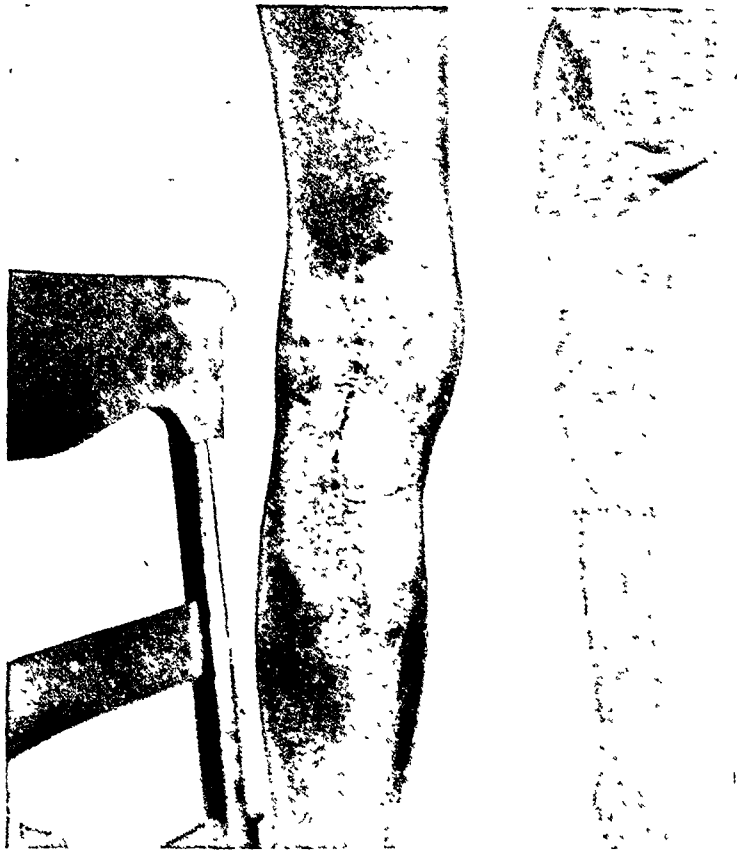


FIG. 4. T. F. Two months after operation. Posterior view.

(Figs. 7 and 8). They were treated by suturing the open mouths of the vessels at their exit from the great sciatic foramen.

Thus is exhibited the successful management at the hands of the average surgeon of a malady otherwise fatal in its ending, the treatment of which under the old methods was, to say the least, unsatisfactory. Thus is manifested the solution of a profound surgical problem by one man, who had the vision to determine the questions at issue and the genius to carry them on to practical performance. I do not hesitate to affirm (and it is no doubt the unanimous belief of all operating surgeons)

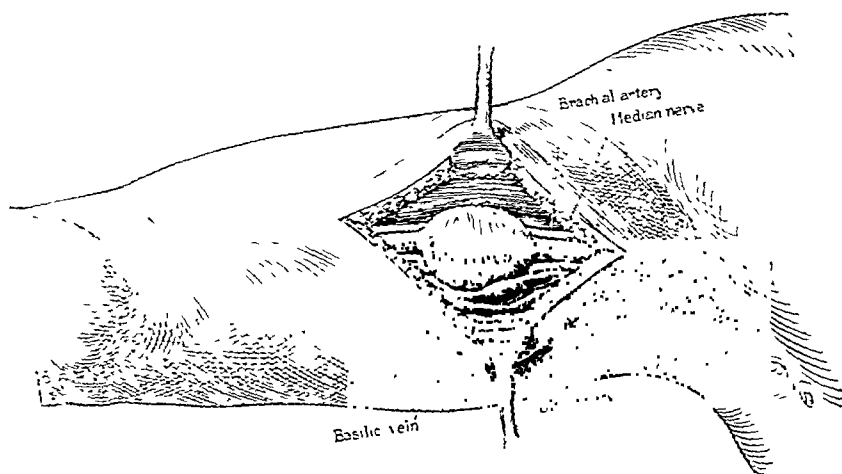


FIG. 5. Traumatic aneurysm of the right brachial artery, with accompanying thrombus of the basilic vein.

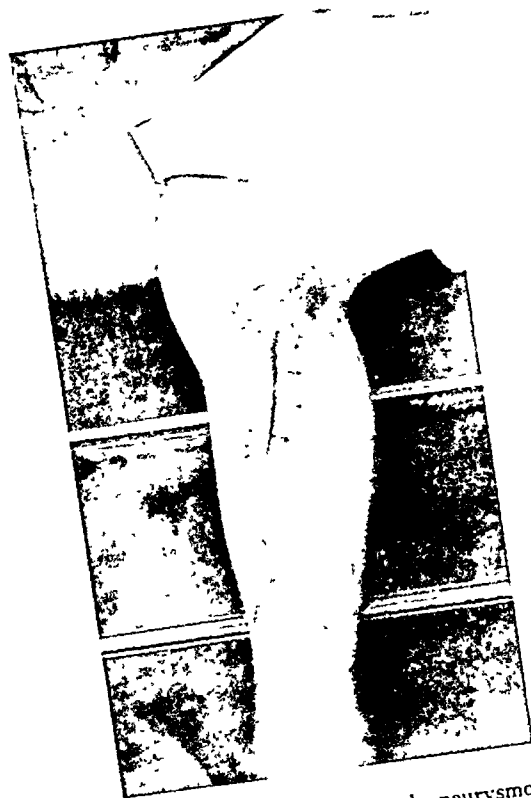


FIG. 6. Patient three weeks after reconstructive endoaneurysmorrhaphy for aneurysm of the brachial artery.



FIG. 7. Large aneurysm of the left buttock, patient lying partly on abdomen with left thorax slightly elevated. Before operation.



FIG. 8. Patient two weeks after operation for huge aneurysm of the sciatic artery.

that the Matas principle of suturing inside the sac, in whatever way may be indicated, has completely revolutionized the treatment of aneurysms, providing the surgeon mental, moral and physical equipment which never existed under methods previously practiced. Clearly endoaneurysmorrhaphy is not adaptable to all types of aneurysms. Ligations will continue to be done in certain conditions, for positive reasons or negative indications. But the Matas idea has prevailed, because it is founded on carefully thought-out postulates, because it is easily and safely performed and because it yields beneficent results. Those of us who have cared for aneurysms both before and since the régime of Matas are able to appreciate the difference; we now approach the aneurysm patient with a degree of confidence never known in the older period. For the successful issues in my limited experience all honor to Rudolph Matas.

HALSTED THIRTY-SIX YEARS AGO

(WILLIAM STEWART HALSTED, PROFESSOR OF SURGERY,
JOHNS HOPKINS UNIVERSITY AND CHIEF SURGEON,
JOHNS HOPKINS HOSPITAL, 1889-1922)

JOSEPH COLT BLOODGOOD, M.D., F.A.C.S.

BALTIMORE, MD.

IT WAS my good fortune, through William Osler, to receive an appointment on Dr. Halsted's staff of the Johns Hopkins Hospital in May 1892, thirty-eight years ago. Before coming to Baltimore I had witnessed some of the operative and experimental work of Nicholas Senn in Milwaukee and of his associate Dr. Mackey. Senn was familiar with the best in German surgery and Mackey the Edinburgh school. Then there were my four years in Philadelphia with periodic visits to New York and Boston. After spending about six months of a very intensive experience with Dr. Halsted in his Baltimore clinic, I visited the clinics in most of the countries in Europe for a period of almost one year. When I returned to Baltimore I was given the opportunity to work directly under Halsted as his resident surgeon.

I have had for many years, even before Dr. Halsted's death in 1922, a hope that I should find time and opportunity to record my memory picture of this great surgeon's conceptions and executions in the science and art of surgery and surgical pathology.

Fortunately I delayed, because in this time of postponement, the greatest contributions of Halsted had crystallized and second, the proper opportunity has arisen. A congratulatory volume of papers is to be presented to Rudolph Matas, Professor of Surgery, Tulane University, New Orleans.

These two men, Halsted and Matas, were always unusually friendly and constituted what may be called a "mutual admiration society." I know this from what Halsted repeatedly

told me about Matas, and Matas' estimation of Halsted's friendship and contributions to the medical sciences has been published in the first volume of the Surgical Papers.

This brief statement becomes in fact a personal letter to Matas himself, for I know he will understand and enjoy a true picture of Halsted in the earliest decade of his great work, a period about which Dr. Matas can only read, because his personal acquaintance with Halsted began later [1903].

The year 1894, thirty-six years ago has been selected because at that time I could compare Halsted's conceptions of the science and art of surgery and surgical pathology with those of Senn and Mackey in Milwaukee, with my surgical teachers at the University of Pennsylvania up to 1892, and with the most prominent surgeons and teachers of surgery in New York and Boston. Then, after a period of one year and six months, in association with Dr. Halsted, I was in the fortunate position to compare this experience under Halsted with that under European surgeons.

There has never been quite such a period in medical science in all its branches since that decade from 1890 to 1900. During this time asepsis and antisepsis were established as well as practically all the surgical technique of incisions, exploration, closure of wounds and the most extensive dissecting operations for malignant disease.

For the statements made here from memory and which may not appear among the Surgical Papers of Dr. Halsted, I have verification in the records of the surgical histories of Halsted's clinic in Johns Hopkins since 1889.

The facts which I have decided to record are not selected because of their historical value *per se*, nor necessarily because they were Halsted's greatest achievements, but because of their value to the young surgeon and surgical pathologist of today. It is an attempt to record unadorned those conceptions and executions of Halsted as a surgeon and pathologist which are just as important today as then. Osler frequently spoke to us in early days at Johns Hopkins of the great value of a book or a series

of volumes which would record the fundamental contributions of men. All other statements and writings, no matter what their historical worth, should be disregarded in this so-called abridged edition of the writings of the great masters.

Surgical Technique. Antiseptic and Aseptic Surgery. The Bloodclot in the Management of Dead Spaces and the Treatment of Wounds. These are the titles used in the first volume of Halsted's Surgical Papers by the editor in grouping together a number of writings. All of these contributions of Halsted, except one on aseptic surgery, which was made in New York in 1884, were written by Halsted in the first few years after the opening of the Johns Hopkins Hospital in 1889.

I know from personal conversations that all of these principles were conceived and most of them practised by Dr. Halsted in his brief surgical career in the hospitals in New York City. So really my record of his conceptions and execution of aseptic and antiseptic surgery should go back to 1884 at which time the contrast of his technique with that of others was greater in favor of Halsted than later.

It may be stated here that Halsted's technique to prevent the infection of a clean wound and to take care of an infected wound ranked with the best in the world, and there were very few surgeons whose execution equalled that of Halsted during his operations at Johns Hopkins Hospital. As recorded by Halsted in his writings and as observed by his associates, the only change in the operating-room technique since 1889 is a long-sleeved gown, rubber gloves and the face mask. That alcohol has been substituted for permanganate of potash and oxalic acid followed by immersion in 1:1,000 bichloride may save time, but we have no evidence that it is a better preparation. The present disinfection of the hands also saves the hands of the surgeon. Both the solutions of bichloride of mercury and carbolic acid were irritating to the hands. Some of Dr. Halsted's associates still use this technique, and one only has to look at their hands to know it.

Halsted boiled his instruments in a soda solution as recommended by Schimmelbusch, and placed them in a 1:30 solution of carbolic acid, because the soda solution made the instruments too slippery. Even after this he still feared the danger of recontamination of the instrument during the operation. Also, in the early years, even clean wounds were irrigated with 1:1,000 bichloride of mercury, except, of course the peritoneal cavity. This was ultimately given up, because in spite of it wounds suppurated and there were a few cases of poisoning resulting in a few deaths.

In all the conversations that I had with Halsted, Welch and others I never could get any evidence that the extensive experimental work so persistently pursued at Johns Hopkins Hospital during the first few years had any influence whatever on the technique in Dr. Halsted's operating rooms, or in the wards. That is, Halsted started his operative technique at Johns Hopkins in 1889 as a finished product, which must have been thought out and practised in New York.

Evidence in favor of the perfection of Halsted's technique is found in the actual healing of his wounds, as compared with the wounds of other surgeons throughout the world. No one, however, at that time had accomplished the practically perfect healing of every clean wound which had been closed without drainage.

Halsted, however, failed in his delayed recognition of the full value of rubber gloves. There is no question that the rubber gloves were in the operating room in 1889. The intern who handed the instruments which were immersed in carbolic acid wore rubber gloves to protect his hands from the carbolic acid. The nurse who squeezed out the gauze sponges wet in 1:1,000 bichloride of mercury solution also wore rubber gloves, because Halsted felt that the more gauze was handled by the bare hands, the greater was the danger of hand infection. He also knew that no method of hand disinfection had yet been devised which would entirely eliminate as a source of infection, by the most virulent pyogenic organisms the bare human

hand and the skin in the field of the operation. Gloves in Halsted's operating room were in constant use by two members of the operative group and occasionally used by Halsted himself in operating upon joints, yet, it was seven years (1896) before it became the practice of everyone who cleaned up for the operation to wear these gloves as a routine.

The moment this routine use of gloves was adopted the suppuration of closed wounds, for example in inguinal hernia, fell from more than 9 per cent to less than 0.5 per cent.

Since this period (1896 to 1898) there has never been a time when the healing of closed clean wounds without drainage exhibited such perfect results.

I can not here write the chapter of the effect of the first and subsequent epidemics of influenza and its concomitants on the infection of wounds during operations.

Just why did Halsted's unusually accurate, keen and original mind fail to realize that the handling of silk which he buried in wounds was just as dangerous as the handling of sponges by the nurse, when he gloved the hands of the nurse, but not his own?

Before the routine wearing of gloves Halsted had substituted buried silver wire for silk, not because he wanted stronger suture material, but because silver wire was the only metal that could be safely buried and had definite antiseptic action. Very quickly after gloves were employed Halsted returned to the use of buried silk for sutures and ligatures and experienced practically no trouble.

Apparently Halsted was not responsible for the introduction of the gowns with long sleeves and the mouth-piece. With the exception of this, Halsted's technique for the protection of wounds made at operation, or at least the principles of this technique, are universally accepted today.

Handling of Tissues. When I came into the operating room in Johns Hopkins Hospital in May 1892 and assisted at operations, I was most impressed with Halsted's gentle handling of the tissues. He cut with the knife, blunt dissection was a

horror to him. He employed a fine straight clamp, so that only the least bit of tissue would be crushed in catching the bleeding point. In ligating this he used the finest silk, first, because it would leave the smallest foreign body in the tissue; second, if one used force to tie the knot, the silk broke, thus preventing strangulation of the tissue. No surgeon up to this time whom I had seen operate seemed to have equalled Halsted in gentleness in cutting tissue, in clamping of bleeding points, or in employing the sponge and in retracting. This was an invariable rule in all operations.

Ligatures and Sutures. The employment of fine black silk as a ligature and a suture when the latter was possible characterized the Halsted clinic, and most of the men trained under him still prefer the fine black silk when possible. Halsted abhorred catgut. In the first place, he was skeptical of whether it could be properly sterilized. Postoperative tetanus was still being observed, on rare occasions, when wounds were closed with catgut. This danger now, of course, is over. For larger vessels he employed a heavier silk for ligation. For the closure of deeper wounds where the fine silk did not seem to be sufficiently strong, he used heavier silk, but later changed this to buried silver wire and reduced the number of wound infections and stitch sinuses. In later years, after the introduction of gloves, he returned to fine silk for the closure of the hernial wounds, and in the development of his operation for the excision of the thyroid gland. Irrespective of the pathologic condition he preached and practised to the end of his operative career the employment of the fine silk for all ligatures during this bloody operation. I observe that today many of the younger men are beginning to learn that if they use fine silk during thyroid operations, fewer infections of the wound follow. Halsted wrote in 1890:

I believe that the obstruction to the circulation produced by sutures and ligatures is often the immediate cause of suppuration in infected wounds . . . The complete strangulation of large masses of tissue we try to avoid by using very weak silk . . . The occasional breaking of the silk reminds one that he is tying with too much force.

This danger is not so great when gloves are employed and wounds are drained. I have observed continuously from the time I saw Senn operate in Milwaukee in 1885 up to today and in the majority of the operating rooms that surgeons seem to fear to use weaker catgut or silk for ligatures or sutures, and when they tie they use too much force. I find that in most of the operations fine black silk or 00 chromic catgut meets the demands.

Checking of Hemorrhage. Halsted outdid Pean in the number of clamps employed during an operation and in the number hanging to the wound at the same time. In spite of the number of surgeons that I witnessed operate in this country and abroad, I never found one who equalled Halsted in the almost absolute bloodlessness of the operative procedures.

Gentleness in the handling of tissues, in the ligation of bleeding points, the use of fine silk, and the checking of hemorrhage and the closure of wounds as a rule without drainage characterized Halsted's operative technique as that of an early master, and all the fundamentals which he worked out then more than forty years ago, hold good today. As he did not wear gloves in the early years, the dangers of the least change from his protective technique were greater than today when the operator has the protection of gloves.

Drainage. Most surgeons in 1890 were draining the majority of their wounds. Halsted rarely drained any wound. All of his resections of joints for tuberculosis were closed without drainage. When wounds broke down he opened them and washed them out, but did not introduce drainage. In 1893 I assisted Dr. Halsted in the reamputation of the arm of a very intelligent geologist. The first amputation had been performed on the field of battle; the wound had been closed without drainage. This patient remembered the months of agony during which the suppurating wounds healed by granulation. Then there was a second amputation because of a neuroma, and the wound was drained and dressed frequently. This patient was very much disturbed when the wound was

not dressed for two weeks, and when it was exposed and the patient was unable to see suppuration or a drainage tube he remarked that it was one of the greatest wonders in the world, in spite of the fact that he was in command of the first party that successfully shot the rapids of the Colorado river through the Grand Canyon. Halsted felt that drainage tubes and gauze packed into clean wounds acted as foreign bodies, lowered the resistance of tissues to infection, and the tube and gauze coming out into the open air left a portal of entrance for secondary infection. It was his opinion that if a wound required drainage, it should be left open, and if a clean wound became infected, it should be opened at once. Even in those earliest years, if there was any sign of fever, it was Dr. Halsted's practice to open the wound at once sufficiently to get a drop of serum for a cover-slip examination, and if organisms were found in the serum, the wound was gently opened in one or more places and washed out with 1:1,000 solution of bichloride of mercury.

When a joint was opened because of infection the joint cavity was thoroughly irrigated with bichloride, but no drainage material of any kind was introduced into it. One or both lateral incisions made for washing out the joint were left open for drainage and repeated irrigations if necessary. Years ago I made a very elaborate report on the success of this method in joints infected with the gonococcus, the streptococcus, the pneumococcus and the staphylococcus. This method of treatment only failed when we overlooked the bone focus, and in a few instances the infection of the joint secondary to the focus in the bone was checked and the joint wound healed, and joint motion was partially restored before we suspected, discovered and opened the infection of the bone.

When Halsted found it necessary to drain he used as a rule iodoformized gauze, very abundantly, now and then combined with rubber tissue. When for some special occasion or indication he felt it necessary to keep one or more channels open into a closed wound, Dr. Halsted employed rubber tissue to the preparation of which he gave much attention. The object of

this rubber tissue was to drain a space in the wound with the least traumatism that would allow vent to any secretion and could be removed with the least danger of producing hemorrhage in the granulation tissue. This rubber-tissue drainage which has been largely supplanted by thin rubber-glove material is still one of the essential features of proper drainage unless we propose to carry on, if indicated, the Carrel-Dakin method of continuous flushing with the disinfectant.

As I think over Halsted's discussions and practices in the treatment of infections and postoperative infected wounds I feel that he almost grasped and anticipated the Carrel-Dakin method. The one or more tubes used by Carrel are equivalent in their non-irritating effect to rubber tissue, but these tubes allow the almost continuous flushing of the wound with the Dakin solution. Halsted conceived the necessity of frequently irrigating an infected wound with an antiseptic. He used 1:1,000 bichloride solution which, we now know, is too strong. However, when Halsted applied the almost continuous irrigation in gonorrheal urethritis, he started with a very weak solution, gradually increasing its strength.

The Management of Dead Spaces. A discussion of this problem has a very large space in my memory centers, but I can not express it better than in Halsted's own language:

Of great consequence is the management of the dead spaces in wounds. These may be obliterated, drained, or allowed to fill with blood. The more imperfect the technique of a surgeon, the greater the necessity for drainage. The most rigid antiseptic precautions are demanded for the obliteration treatment of dead spaces.

There is no question that many of Halsted's intended blood-clot closures of dead spaces succeeded, especially those in which the cavities were swabbed out with pure carbolic acid and alcohol. In such instances Halsted followed Lister's technique in the treatment of compound fracture. This was the beginning of antiseptic surgery. Lister described the healing of a blood clot under a scab in 1865. Halsted was constantly attempting it in the early years of his operative experience.

Later he was rather inclined, when the dead space could not be obliterated, to drain it. Nevertheless this strenuous attempt deliberately to fill a dead space with blood after disinfection, and to close the wound, must have had a beneficial influence in the development of as perfect a technique as was possible with asepsis and antisepsis before the employment of gloves.

When I entered Halsted's clinic in May 1892 as his youngest assistant he told me to read everything that Lister had written. When I went to the little library in the Johns Hopkins Hospital I had no difficulty in finding the correct places in all of Lister's articles published in the *Lancet* and in the *British Medical Journal*. Each article was indicated by a torn piece of blue paper which Dr. Halsted always employed in his correspondence. Thirty years later, when we sat in Halsted's library during his funeral services and I looked about on the books on the shelves around the four walls, I could see protruding from the top of almost every volume little pieces of blue paper. I advise any young surgeon who reads this article to do as I was advised by Halsted: read everything Lister wrote. To this I would add: Learn by heart everything that Halsted has written in his Surgical papers recently published in two volumes. Then get hold of the best literature on the Carrel-Dakin method in the treatment of wounds. Then you will be prepared to aid in the problem of the protection from infection of our operating wounds today when even a mild epidemic of respiratory diseases occurs in your community and in your hospital.

There is no question that in the majority of surgical clinics today during the months most free from respiratory infections, there is the least number of wound suppurations. Since the pandemic in 1918 it has become even more evident, because more frequent and less virulent, but almost annual outbreaks occur. My colleague Dr. Ford, of the Department of Bacteriology of the School of Hygiene of Johns Hopkins University, expresses the opinion that the organisms come from the mouths

of individuals in the operating room who are nearest the wound. The gauze mask over the mouth and nose is not sufficient. It is his opinion that cultures and cover-slips should be taken of the mouths of all who enter the operating room and when virulent organisms are found these individuals should be excluded. At the present time in the operating rooms at St. Agnes Hospital, we are not only flushing the wounds, other than those made at laparotomies, at the end of the operation with Dakin's solution, but introduce rubber tubes into the most important dead spaces and flush them continuously for some hours. Just as we started this method there was a decided drop in respiratory infections.

No one seems to be giving these occasional wound infections during the height of an epidemic the attention they should receive. We must remember that Lister and his followers achieved remarkable success in dirty hospitals filled with pyogenic organisms. Halsted and his associates were aided, because they were working in clean modern hospitals. Nevertheless under these most favorable conditions and before the routine employment of rubber gloves the introduction into the hospital of a streptococcus infection or a case of erysipelas was usually followed by a streptococcus infection of a clean operative wound, provided one of the surgeons or nurses whose hands came in contact with the discharges from the streptococcus wound assisted at an operation within a few days. I have reported such instances occurring in the early years of Halsted's clinic, and it was these investigations that lead to the routine employment of gloves not only in the operating room, but in the dressing of all infected cases in the wards, whether isolated or not. It was not until 1918 that surgeons realized the great danger of the infection of clean operative wounds during an epidemic of influenza and pneumonia, and in the twelve years since then nothing really has been done to investigate the problem properly, in spite of a number of deaths even after such simple operations as the submucous resection for a deviated septum.

Halsted in His Operating Room. Unlike most European operators especially in Germany and Italy, Halsted began his operations at ten or a little after. Observe the table, Figure

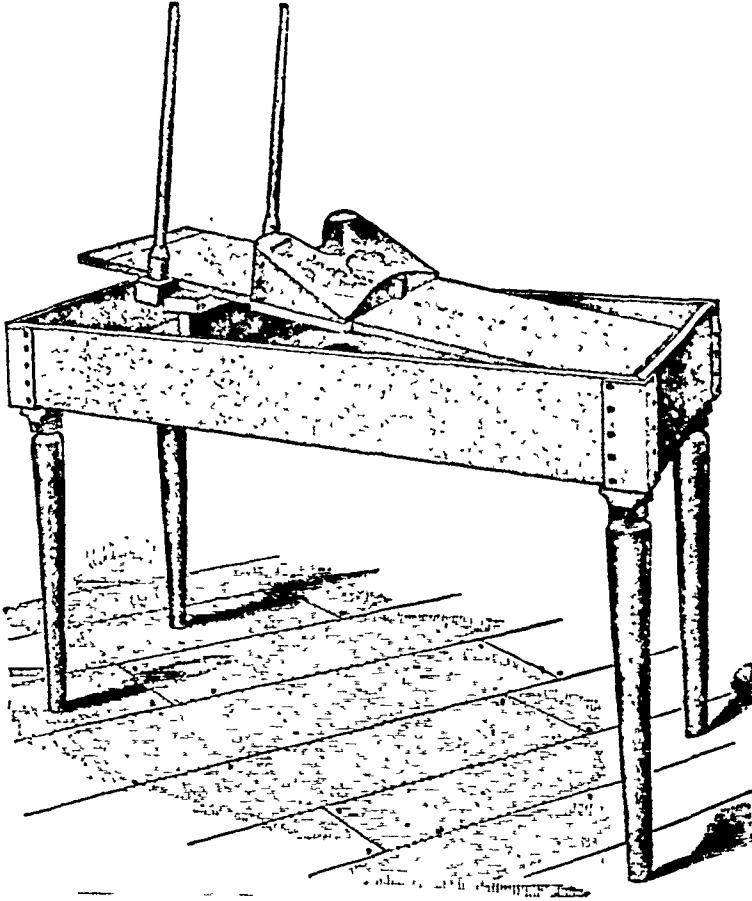
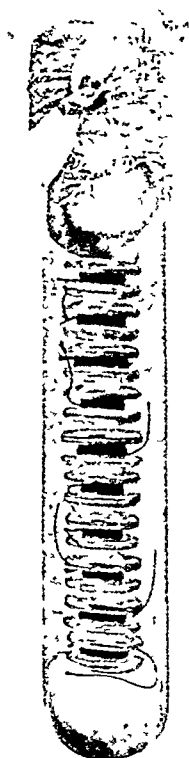


FIG. 1. Halsted's table with perineal board. The patient was anesthetized and lifted into position. The table allows irrigation of the wound without flooding the operating room floor. Halsted anticipated all the modern arrangements for gynecological pelvic operations, prostatectomies. He used this chiefly for hemorrhoidal operations and the Kraske resection for cancer of the rectum.

1. Like everything in the operating room it was built of wood. All the surfaces of wood were kept clean and waxed. The board is shown in Figure 1. When the perineal board was not employed, it rested on the two ends of the table, so that any

irrigation employed in the wound could be caught in the open box table beneath. Trendelenburg position could be easily maintained by lifting the ends of the board, but we had no shoulder strap, so that an orderly had to hold the legs. In this operating table Halsted gave one of his few examples of inattention to some important details. For example, the difficulty of maintaining the Trendelenburg position, and the fact that the patient's arms had to be held by a nurse or orderly during the operation for cancer of the breast with the danger of over extension and temporary brachial plexus paralysis. With very few exceptions the fundamental principles of every detail of the entire operative technique from the preparation of the patient the night before, to the return of the patient to the ward, had been worked out by Halsted himself. These are still very worth while reading by internes and nurses to help them in their operative room behavior. In all my experience, up to that time and since, I have never witnessed such intelligent and conscientious attention to the most minute detail. The nurse who rolled the silk on the glass spools and threaded the fine silk in the fine, straight intestinal needles (Fig. 2) or prepared iodoformized gauze, cleaned up as for an operation, and in my recollection wore rubber gloves. I can find no statement as to this, nor photographs. All gauze and towels, and sheets were sterilized by steam in the Arnold sterilizer by the fractional method, I think for one hour or more, daily for three days. This had its disadvantages in an emergency or when the stock was exhausted in one day, because of many emergency operations. At this time at von Bergman's clinic in Berlin the single sterilization in cylinders, under pressure, were employed. That was the result of Schimmelbusch's experimental work. I do not remember it in this country, at this period. Halsted was most particular about the preparations in everything he employed, regardless of expense of money, and the time or energy of those upon whom this duty fell. It was shown in the adhesive straps, the special bandages, the extension apparatus for fractures. To repeat, I have visited



A



B



C

FIG. 2.

many clinics throughout the world, but in not a single surgical clinic was the chief so absolutely responsible for every detail, most of which he had thought out himself.

It is to be remembered that Halsted had a quiet period between the end of his intensely active operative and teaching career in New York City, and his launching of the surgical clinic at Johns Hopkins in 1889. There is every evidence that he employed this in experimental work in Welch's Pathological Laboratory, in thinking and in testing out by operations on dogs, the finest details of aseptic and antiseptic technique based upon his experience in New York. We must also remember that during the period when the work in the Welch Pathological Laboratory represented the activities of the new hospital group, there was a very intense study of hand disinfection, and this continued during the early years of the hospital. However this bacteriological investigation failed, because it did not lead to the long sleeved gown and the rubber glove.

Halsted was the first operator with whom I came in contact, who insisted upon operating with the smallest amount of ether anesthesia. In Philadelphia I was always told to give more ether, by Halsted to give less ether. In the Johns Hopkins Clinic the chief surgeon also employed a cone, which allowed the giving of ether with more air.

In the preparation of the patient, during the entire operation, and in postoperative treatment, Halsted was one of the few surgeons of his time to think constantly of the prevention of shock. Keep the patient warm, reduce the amount of anesthesia, if possible, use local anesthesia, lose no blood, protect the intestines with gauze moistened in warm salt solution, specially prepared by fractional sterilization. Halsted had no faith in stimulants for shock beyond putting the patient in bed, elevating the foot of the bed, giving morphine sufficient to relieve pain and restlessness, and giving fluids by rectum. He employed no postoperative stimulation. We observed the least shock in our longest operation, the complete operation for cancer of the breast, because during this operation one

was able to control anesthesia, hemorrhage, and the gentle handling of tissue.

During the operation Halsted was a surgeon, a pathologist, and a thinker. He always had in mind improvements in the operative procedure and carefully studied every bit of tissue exposed by the knife.

The only omission which deserves criticism is that Halsted rarely dictated anything that he did or observed during the operation. This was always left to others. As I have a number of records written or dictated by Halsted himself during my resident surgeonship, I can estimate the great value if more of them had been left behind. In the years before my coming the resident who wrote up the operation, confined his notes to technique, the number of clamps employed, the detail of the skin incision, the time of the operation, and the closure of the wound. Naturally during my resident-surgeonship, due to Dr. Halsted's influence and suggestions, we made most minute note of the operative findings and the gross pathology, and after the operation voluminous notes on the gross and microscopic pathology. These appear in my records, but in the early years they largely represent Halsted's observations, of which I was chiefly the recorder. In all these contacts one was continuously impressed that Halsted was an intellectualist, with a most remarkable memory for what he read and what he observed with his naked eyes. He was not as interested in the immediate observations of microscopic pathology, as up until 1915 it was of no particular value in the operating room, and was just as useful to him in the form of a report. Halsted never lost his vigilance in observations of technique and tissue, whether he operated himself or observed an assistant.

I hope that the younger members of the surgical profession will read in detail in Halsted's Surgical Papers what he has recorded on technique. This is especially necessary today, because we do not command asepsis as we did in Halsted's operating room from 1896 to the pandemic of the influenza in 1918. We have also forgotten the value of surgical bacteriology

in the operating room and have neglected the study of every type of infection, wound or not. The value of disinfection with antiseptics in the earliest hours of the contamination of the wound, learned during the War, is being considered *less and less* today.

Halsted gave surgical bacteriology and pathology an equal place in his department, both in the operating room and in the wards, as well as in Dr. Welch's Department of Pathology.

BREAST

Halsted's Complete Operation for Cancer of the Breast. Billroth's conception of the complete resection of the stomach for cancer antedated Halsted's complete operation for cancer of the breast, but Billroth laid no stress on the complete removal of the glands in the lesser and greater curvature. Halsted seems to have been the first to conceive the *en-bloc* dissection of the primary tumor with the neighboring lymphatics and all other tissue which might be involved by direct infiltration of the cancer cells, whether into the lymphatics or to zones about the original tumor. Halsted's complete dissection of the breast, the axillary glands and large portions of both pectoral muscles went as far as was anatomically possible. There is no question that this *en-bloc* dissection was conceived and executed before he came to Johns Hopkins Hospital in 1889. However, in his first report on fifty complete operations in 1894 the first operation recorded is May 28, 1889, and no mention is made of previous operations in New York.

Halsted was never able to describe his technique in detail, nor has it ever been properly illustrated by drawings or photographs. The technique can really only be learned by assisting someone who has acquired the details from one of Halsted's associates who learned it while assisting the originator himself.

Figure 3 (P.No.227) is a photograph of the oldest living patient operated upon by Dr. Halsted for cancer of the breast. This was in 1892, thirty-eight years ago. This patient today at the age of eighty-two is in good health. You will observe



FIG. 3. Photograph of result thirty-eight years after Halsted's complete operation for cancer of the breast.

that there is no swelling of the arm and perfect use of it. The wide scar on the chest wall represents the wound that healed by granulation. Skin-grafting of the open wound was begun in



FIG. 4. Brödel's diagram of Halsted's incision. Note that the tumor, not the nipple, is the center of the skin area.

1893. You will also observe that there is practically no pectoral muscle visible. The fold of skin passing from the chest wall to the arm is scar tissue and indicates that in the early years the skin incision extended down on the arm. This is the usual result after a properly performed Halsted operation.

Figure 4, the drawing by Brödel¹ made in 1893 demonstrates that the area of skin encircles the tumor and nipple and then removes sufficiently more skin to allow the complete removal of all breast tissue. Operators even today, when confronted with the earliest and smallest breast tumor, should still follow Halsted's original idea that the tumor should be the center of a circular area of skin; then this circular area of skin can be given more margin which will include the nipple and sufficient skin to allow the removal of the breast and leave behind skin of good circulation. The margin of skin given the

¹ Plate XLIX of Halsted: *Surgical Papers*, 2: 50.

palpable tumor increases with the size of the tumor and with the involvement of the skin. When one explores a doubtful breast tumor today, the incision should be curved or straight



FIG. 5. Photograph of the end stage of Halsted's operation taken about 1893.

according to the position of the tumor, so that should the tumor prove to be malignant this exploratory wound can be included in the area of skin which should be the proper area for the removal of the tumor of the size and character explored. Figure 4 is positive evidence that Halsted dissected the skin clean from the subcutaneous fat. Everyone who looks at Figure 6 will agree that the artist has at least portrayed what the operator was most anxious to accomplish—an absolutely clean dissection.

Figure 5 (Plate LI) is a photograph of an operation for cancer of the breast in Halsted's operating room at Johns

Hopkins Hospital in 1893. Proof that rubber gloves were in Halsted's clinic at that date is given in the picture of one hand of which two gloved fingers are shown. This is also positive

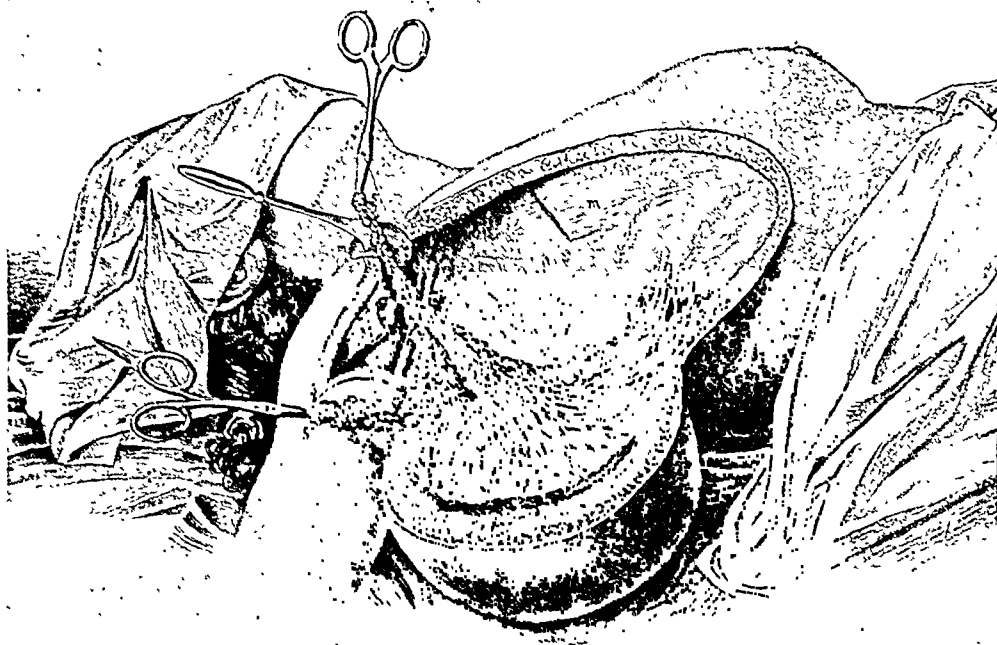


FIG. 6. Brüdel's drawing of the last stage of Halsted's operation.

evidence that he saw no necessity of putting on the entire glove. I have looked in vain for a photograph which would show the nurse or the one who handed instruments wearing gloves. Observe how wonderfully and perfectly draped is the operating field and how conspicuously exposed the hands and arms of the operating team. Everyone connected with surgery was too slow in developing the full technique of aseptic surgery. Most surgeons caught from Lister too much faith in antisepsis.

Figure 7 shows the extent of Halsted's complete dissection.

However, there has never been an illustration, either by artist or photographer, that has reproduced the essential technique of this dissection for the removal of the breast, the muscles and the axilla. That its result is no more disfiguring than the removal of the breast is illustrated in Figure 3.

The actual results five years after operation in every type of cancer with and without axillary involvement and with different extent of axillary metastasis remain as published



FIG. 7. Photograph of complete specimen after Halsted's operation.

by Halsted himself. I am unable to find any evidence from the larger number of operations that there are any more five-year cures or any fewer local recurrences. From an actual operative standpoint the results of the operation performed by Halsted himself, from my studies, have not been improved upon. Nor have I any evidence that preoperative and postoperative radiation has increased the five-year cures. We are not discussing its palliative effects. It is rather interesting that the

same may be said of Billroth's first operation for cancer of the stomach, known as Billroth 1, in which, after pylorotomy and partial gastrectomy, the duodenum is sutured to the stomach. In fact, most gastric surgeons have returned to Billroth 1 whenever it is possible. When indicated, Kraske's technique for the resection of the lower rectum and anus cannot be improved upon. We have had to give up Wertheim's more extensive resection for cancer of the cervix, first, because it has never accomplished a cure when the glands were involved and was unnecessary when the glands were not involved. In spite of the fact that, theoretically, it removed more of the tissue around the cervix, the margin was not sufficient to justify the added risk.

There is no added risk in following Halsted in his perfect and complete dissection for cancer of the breast. As, yet I can find no justification for attempting this any longer with the electric needle.

Halsted's five-year results were as follows: When the highest apex glands were involved 10 per cent of the cases were living apparently free from disease at the end of five years. If the mid-glands were involved 20 per cent were apparently well after this period; when only the base glands were involved the five-year cures were only 25 per cent. These figures were determined in our first study of the five-year results in about 1898. Halsted, in previous publications, selected the three-year limit so there could be comparison with statistical studies already in the literature. Every restudy since then up to date shows practically no variation. I am not prepared to give here the ten-year results. I am attempting chiefly to give the evidence that Dr. Halsted not only conceived, but executed the type of a complete operation for a cancer of the breast which remains the operation of choice today.

In Halsted's clinic each year that the five-year results were restudied the percentage of the total number of cured cases increased. This can be explained by the lessening extent

of the axillary involvement, because, if the axillary glands are not involved, the five-year cures were originally placed at 85 per cent, and ultimately and today are placed at 70 per cent. This apparent fall in the five-year cures of cancer of the breast without axillary involvement can easily be explained by the borderline breast tumors which up to 1915 were included among the cancers of the breast. Since then they have been excluded from such studies. It is this group of borderline tumors without axillary involvement that has always influenced the percentage of five-year cures in every surgical clinic. Very few clinics even today can give their percentages with involvement and non-involvement of the axilla, and still fewer have accurate records of the extent of the involvement of the highest apex glands, and as the five-year figures vary from 10 to 75 per cent, it makes comparison of five-year cures in the different clinics difficult, as well as estimating the curative value of preoperative or postoperative radiation. I feel that I am justified in making the statement that Halsted not only established the fundamental principles of a complete operation for malignant disease, but the fundamental principles of its pathological study and the compilation of records which would make statistical studies of the greatest value.

The surgeon today is confronted with dilemmas both in the diagnosis and in the treatment of lesions of the breast. In the first place, he must decide by palpation whether there is a lump justifying operation. In the early years, of Halsted's experience there was no such difficulty. There was always a definite lump. Halsted was one of the first to personally make so detailed an investigation of the distinction by physical signs between a benign and a malignant lump in the breast. In my opinion this work of his equals that of Laennec. He was opposed to exploration for diagnosis unless all the signs favored benignancy. Halsted's biopsies in 1892 when I first assisted him were as carefully thought out and worked out as today. I will discuss this under pathology. The present-day surgeon and pathologist should be better prepared to settle the dilemma

of diagnosis at the exploration of a breast tumor, because the number of cases today is greater in one year than in Halsted's first ten years of experience.

A further difficulty of the present-day operator is the decision between preoperative and postoperative radiation, and then, when shall the operation for cancer of the breast be restricted. Halsted again and again made the statement which I have been unable to find in his writings: "The surgeon who operates for cancer of the breast should make the incision best for the complete dissection and pay no attention to the closure of the wound. This closure should be performed later by another operator." I have been familiar with the actual results of the operation for cancer of the breast by Halsted and his associates and many other surgeons throughout the world, and there is every evidence that the results after the most complete and painstaking dissection of all that is necessary should be almost as favorable for function as the removal of the breast only. The case of the patient shown in Figure 3 (P.No.227) is selected not because it is the very best but because it is of the longest duration since operation.

All operations planned to avoid skin-grafting or to close the wound by some plastic procedure, or to leave more muscle are of no value. They do not add to function, but they may add to the risk of local recurrence. When the axillary glands are not involved, a restricted operation there involves no risk. It requires, however, an expertly trained operator to tell by palpation only whether the glands are involved or not. Today on account of the larger number of cases of cancer of the breast in which the glands are not involved, the danger of restricted axillary resection is less. Operators who restrict in any way the chest wall operation or the dissection of the axilla do so with risk to their patients both of local recurrence and of leaving an involved gland in the axilla. This risk increases with the extent of the local growth and axillary metastasis. Operators of wide experience in operations of this kind and with pathological knowledge may restrict the completeness of the

operation for cancer of the breast without any added risk to the patient. I know that Halsted never took this risk in spite of the fact that he encountered his share of early cases in the early years.

Halsted's painstakingly clean dissection of the axilla, his wider local removal of skin, subcutaneous fat, muscle and fascia equal his eminence in the thoroughness of his antiseptic and aseptic technique during operations. These two achievements alone have placed him justifiably among the greatest masters both in the conception of original ideas and in their execution, among the surgeons in the early years of modern surgery.

Contemporary literature, but more especially contemporary gossip, would give the impression that Halsted was a slow and somewhat awkward operator and lacked dexterity. This is absolutely untrue as regards those regions with which he was familiar. Halsted abhorred speed in operating which should be called haste. He did not wish to be known as a "brilliant" surgeon. However, in the dissection for the removal of the breast, muscles and axilla and for many other operations he could be and was brilliant in the execution. In the operation for cancer of the breast he used the knife blade throughout; everything was cut cleanly, there was no blunt dissection. Every bleeding point was clamped gently. Every branch of the axillary vein and artery was absolutely isolated from all surrounding tissues before it was clamped and ligated with fine silk. When his first two assistants were well trained, Halsted as the operator handled the knife, the dissecting forceps and now and then the sponge, rarely a clamp. The small so-called mosquito clamps were devised by him during the first years of my resident-surgeonship.

I feel that I am correct in stating here that I have never witnessed a surgeon perform a better or more brilliant and at the same time more careful and complete operation for cancer of the breast than Halsted. None of his associates ever surpassed him in this operative manipulation.

Again and again in my writings and teaching I have referred to Billroth, Halsted, Kraske and Wertheim as the four pioneers in the conception and execution of the complete operation for malignant disease wherever it may be situated.

HERNIA

Halsted's Radical Cure of Hernia. When I graduated from the University of Pennsylvania in 1891 no surgeon discussed operations upon inguinal hernia unless there was strangulation. In this event all tried taxis first. There was a rumor that Dr. John B. Deaver had operated upon non-strangulated inguinal hernia in the German Hospital. During one year of internship in the Children's Hospital in Philadelphia, no opportunity arose to assist at an operation for strangulated hernia in a child. Halsted, however, and Bassini had both conceived and executed their operations, the principles of which are followed today. Both these originators of an operation for the radical cure of hernia were of the opinion that the cord was the cause of the hernia and its transplantation its cure. Both of them ultimately learned that the healing of the wound after a good suture of the external ring including the conjoined tendon was followed by a cure in the great majority of cases. In 1892 Halsted made his first extensive publication on his operation for hernia after an experience of 82 cases.

Figure 8* pictures Halsted's typical method. In all his writings Halsted stated that the problem in the cure of an inguinal hernia is to make and properly close a rent in the abdominal wall. When the rent was in the inguinal region there was an additional problem—the position of the cord. In the ordinary laparotomy there was no such problem. Very quickly he reduced the size of the cord by the excision and ligation of the accompanying veins, similar to an operation for varicocele practised before that time through an incision in the scrotum. The illustration shows the denuded cord after ligation of the vein; in the lower angle the stump of the ligated vein. It also

* Pl. XXI, Surg. Papers, p. 282.

demonstrates Halsted's failure either to describe or to illustrate some of the most important details of his operative technique. In the letters *a* to *r* the words "divided internal oblique" do

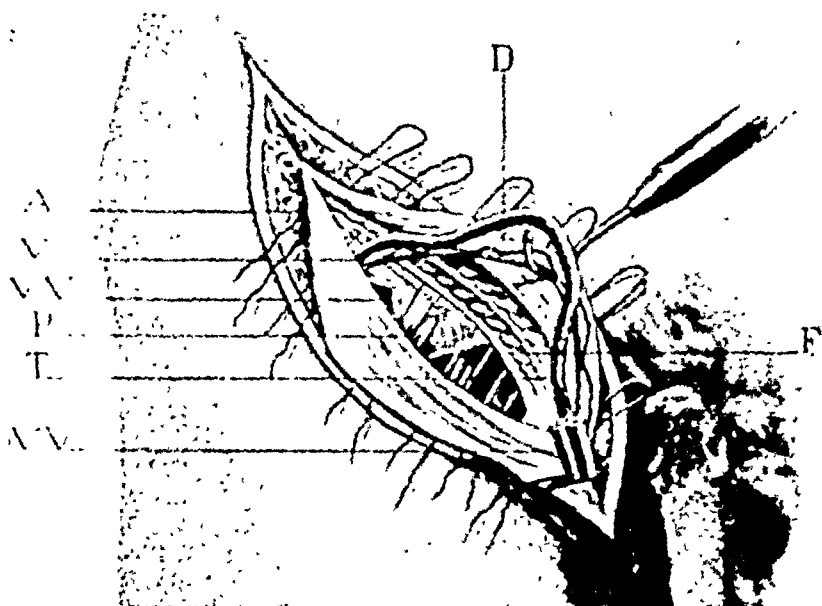


FIG. 8. Sketch of Halsted's operation 1892. *a*, aponeurosis of external oblique muscle; *d*, vas deferens; *f*, fascia transversalis; *p*, peritoneum; *t*, conjoint tendon; *rr*, stump of excised vein.

not appear, in spite of the fact that Halsted considered the division of the internal oblique muscle to allow the high transplantation of the cord as important as the transplantation of the cord itself and its reduction in size by the excision of veins. Fortunately he pictured the conjoint tendon (τ) and taught all of us to be certain that the conjoint tendon was caught in the lowest one or two stitches. I am confident that my memory is right about this. This catching of the conjoint tendon in the last one or two stitches below the transplanted cord as practised by Bassini and Halsted, or above the cord, as emphasized by the majority of surgeons attempting to discover a cure for hernia by a new operative technique, is an essential feature of all operations for the radical cure of hernia. Never-

theless in Halsted's first description he neither mentions by name the division of the internal oblique, nor the importance of including the conjoined tendon in the lowest sutures. As to the tissues cut for exposing the sac Halsted writes: "Throughout the entire length of the incision everything superficial to the peritoneum is cut through." As to the closure of the wound, I quote: "Interrupted strong silk sutures, passed so as to include everything between the skin and the peritoneum, are used to close the deeper portion of the wound, which is sewed from the crest of the pubes to the upper outer angle of the incision."

Now, this can be easily done and the conjoined tendon not caught. This ignorance or carelessness explains many recurrences by other operators in the early years when the wound did not suppurate. In this first presentation of Halsted's in 1890 he emphasized the transplantation of the cord with its veins, the high isolation of the sac and its division and closure above the neck, and the importance of closing the skin with a very fine silk passed subcutaneously, interruptedly, in order to prevent the penetration of the skin with needle or silk. This idea of a subcutaneous stitch ultimately led to the continuous subcutaneous silver-wire suture. He was anxious to avoid the sebaceous follicles. The stitch originated from his experiments on dogs in Welch's pathological laboratory before the opening of the hospital in 1889. In 1889 he presented five operations for the radical cure of hernia before the Johns Hopkins Hospital Medical Society. It is also interesting to note that he used a gauze plug for drainage and then adds that the wound healed *per primam*, except where the gauze plug was introduced. In the last few cases he gave up the gauze plug drainage. I never saw him drain a wound made for the radical cure of inguinal hernia.

To demonstrate Halsted's firm conviction of the necessity of catching deeply the conjoined tendon, I quote from his note on Case 3: "Passes urine through the wound . . . Infer that one of the deep sutures was passed through the wall of the

bladder . . . The patient recovered, the wound healed by primary intention, except in the lower angle through which the urine leaked for a few days, then there was healing by granulation."

In October 1890, eleven months later, he makes another report to the hospital medical society in order to show the perfect healing of the wound and the employment of the sealing or collodion dressing. The patient he demonstrated was the patient just noted from whose wound urine leaked for a few days. There had been the complication of a thrombosis of the femoral vein. There is another important statement here again to demonstrate Halsted's emphasis on the importance of closing the lower angle of the wound: "We take such deep stitches into the pillars of the ring that I am not surprised at this complication." In spite of this statement Halsted was not a good prophet. It never occurred again in any case of which I had a record up to 1900. There is another quotation which again emphasizes Halsted's idea of the value of dividing the internal oblique: "The muscles of the abdominal wall are divided out to the level of the anterior superior spine of the ilium." This is a slight exaggeration, but the principle remains the same. In this very short note in 1890 there is another statement which again emphasizes Halsted's opinion of the value of the high ligation of the sac. He writes: "The walls of the sac are sutured by quilted suture at as high a level as possible." In an earlier paper he writes: "The abdominal cavity is closed by quilted sutures passed through the peritoneum at a level higher by one and one-half to two inches, than the so-called neck of the sac." In this second statement in 1890 he again mentions the transplantation of the cord and its vessels to the outer angle of the wound. Figure 8 pictures the buried mattress sutures which were first of heavy silk and later changed to silver wire.

In January 1892 Halsted presented to the Johns Hopkins Hospital Medical Society cases upon whom he had operated for the radical cure of hernia and added to his technique the

resection of the veins if large. Here is a quotation which again shows Halsted's feelings about the relation of the cord to recurrence of the hernia: "By this procedure the cord may often be reduced to less than one-fourth of its original size. It is reasonable to suppose that the size of the cord may influence the tendency of the hernia to return."

Now let us turn to Halsted's paper in 1892 from which I have taken Figure 8. There is a report of eighty-two cases. The paper was delivered in 1892 but not published till 1893, so there was the addition of some cases, but no new statement of facts. I was present when Halsted delivered this paper in November of 1892. Remember, this is almost forty years ago, and Halsted's writings show that the radical cure of hernia was one of the great problems occupying the minds of ambitious progressive surgeons. At this time the majority of surgeons of the world advised a truss for a reducible inguinal hernia, and with few exceptions operated only for strangulation. However, there were a number of venturesome operators who were attempting to find a cure by operation for an inguinal hernia. Halsted in his paper goes over the ground briefly, but sufficiently, so much so that when in 1899, seven years later, I made my report on 500 operations for the radical cure of hernia, I did not discuss the literature. I have already stated that ultimately we all learned that the chief cause of recurrence was suppuration. For example, in my studies in 1899, with the exception of those cases in which the conjoined tendon was obliterated, recurrence took place after Halsted's radical operation in from 1 to 6 per cent, while in suppurating wounds in from 7 to 36 per cent. In 1892 Halsted writes: "Shuh said: 'If no other field were offered to surgeons for their activity than herniotomy, it would be worth while to become a surgeon and devote an entire life to this service.'" As a matter of fact, from 1893 to 1899, during which time I was Halsted's resident surgeon, we devoted a large part of our time to the radical cure of hernia. Practically every patient was sent for and examined, and Halsted worked with me in the large report

which I published in the *Johns Hopkins Hospital Reports* in 1899. It was this study that led Halsted and myself to conclude that the division of the internal oblique was unnecessary, that the transplantation of the cord was also unnecessary, except when the conjoined tendon was obliterated, and then there must be a transplantation of the rectus muscle or of its sheath. There was no longer necessity to use silver wire or heavy silk, because the introduction of rubber gloves made buried silver wire unnecessary, and Halsted himself found that the wound could be closed in layers with the finest black silk used as an interrupted stitch. In his latest studies with Taylor, the chief cause of recurrence was not suppuration, but the failure of the individual operator to follow out the details of the closure of the wound, or to recognize the absence or partial obliteration of the conjoined tendon.

Halsted himself gives equal credit to Bassini. Neither knew of each other's ideas. When I visited Europe in 1893, I saw hernia operations chiefly in Bassini's clinic, in addition, a great many patients recovering from the operation. As I made rounds with the younger doctor in Bassini's clinic, I found the hernia wounds suppurating as frequently as in Halsted's clinic, and both chiefs of the clinics equally ignorant of the actual percentage of their wounds that broke down.

When I compared the operations of Bassini and Halsted as practised by the authors or their followers, there seemed no question that the chief feature of the Bassini and Halsted technique was the closure of the wound and not the transplantation of the cord. Also, these two surgeons had distinctly less frequent recurrences even when their wounds suppurated than other operators.

The last report on hernia from Halsted's clinic, by Taylor, clearly demonstrates that the perfect healing of the wound will not protect the patient from recurrence unless the operator is familiar with the proper technique of closure and follows it in painstaking detail.

In 1894 Halsted reported on the use of silver wire sutures as a substitute for buried silk sutures. Later came the covering of the wound with silver foil. In spite of this the suppurations were reduced to only 9 per cent. After 1896 the employment of gloves as a routine reduced the suppuration of wounds to less than 1 per cent. In 1895 Halsted wrote again:

The problem is to close a durable rent in the abdominal wall and to provide for the safe transmission of the spermatic cord. The cord is the first cause of the hernia and the ultimate obstacle to its cure. The larger the cord, the greater the liability to a recurrence of the hernia. The size of the cord depends chiefly upon the vein. Then, why not reduce the size of the cord by excising the vein as may be superfluous?

Again in 1894 he emphasizes the importance of the division of the internal oblique. He writes:

It has been demonstrated too often that the stitching of the pillars of the ring does not suffice. We must do more than bring free edges of the aponeurosis of the external oblique together. Fortunately we have muscles so near at hand and so placed as to suggest at once a simple and what has proved to be an entirely effective plastic operation. After cutting through the anterior wall of the canal down to the sac we continue the incision in the same line outward and a little upward, through the internal oblique and transversalis muscles for an inch or less.

This is the first time he has mentioned the internal oblique muscle.

Later Halsted made two very important additions to the operative technique: the employment of fine black silk as an interrupted suture in closing the different layers of the abdominal wall over the non-transplanted cord. Our catgut today is so good and the 00 sufficiently fine that there seems no objection to its use if there is any tension. However, I still prefer fine silk.

In 1903 Halsted reported on the transplantation of the sheath of the rectus muscle instead of the muscle itself and Figure 9 illustrates this. This was suggested as a substitute for the transplantation of the rectus as advocated by Woelfler and myself in 1898.

It was a great education to anyone to be with Halsted when he was studying in most minute detail the proper operation for the radical cure of hernia. It was some years before he

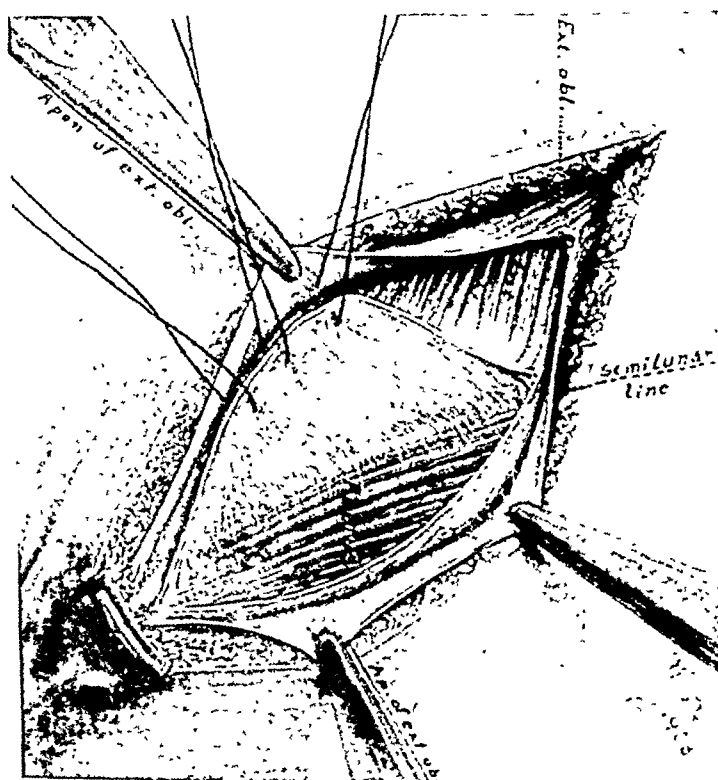


FIG. 9. Halsted's transplantation of the rectus sheath, 1903.

recognized that it was his method of suturing the wound rather than transplanting the cord that accomplished the results.

Halsted's Operation for Inguinal Hernia as Performed by Him in Later Years. Poupart's ligament and the aponeurosis of the external oblique muscle were carefully and completely exposed. Then the aponeurosis was divided from the external ring until the inguinal canal and the internal oblique muscle were exposed, and the rectus sheath in the lower angle brought well into view. The covering of the sac, whether it contained much cremaster muscle or not, was divided, carefully, and preserved. The sac was separated, clean from all its surround-

ings, and the peritoneum above the neck of the sac exposed. The sac was opened, its contents inspected and managed, the internal ring was always divided, so that the peritoneum could be closed above the neck of the sac, and the sac removed. The conjoined tendon was carefully palpated and inspected. If it was wide and strong the layers were approximated with interrupted, and as a rule single, fine black silk, now and then a mattress suture was employed. The coverings of the sac were first approximated, then the conjoined tendon and the edge of the internal oblique muscle were sutured to a fold of Poupart's ligament and the aponeurosis of the external oblique, some distance from the edge. The cord had not been disturbed and the lower suture fitted snugly over the cord. The internal oblique muscle had been so separated that it was loose and could be approximated to Poupart's ligament with the conjoined tendon without tension. Then the edge of Poupart's ligament and the aponeurosis of the external oblique muscle were sutured to the rectus sheath, the fascia of the linea semilunaris, and the internal oblique muscle. The third layer was the aponeurosis of the external oblique to Poupart's ligament. In Halsted's original operation the internal oblique muscle was divided, the veins removed, the cord transplanted into the upper angle of the internal oblique, and all the tissue below the cord were approximated beneath the cord, by a single row of heavy silk or silver wire mattress sutures.

If the conjoined tendon was weak, narrow or obliterated, the cord was isolated and transplanted, without division of the internal oblique muscle. Then a triangular flap of the anterior rectus sheath was made, turned down, and sutured to Poupart's ligament, making a new conjoined tendon. Then everything was closed as previously described, but beneath the cord, and the cord laid between the aponeurosis of the external oblique and the subcutaneous fat rather than between the aponeurosis and the next layer as in Bassini's method.

This imbricated suture in layers is credited to Edwin Andrews of Chicago. The modern operation by Halsted had,

therefore, become a composite or joint affair, but nevertheless, the principles originated by Halsted of the making and closing of a rent in the abdominal wall were maintained. When the conjoined tendon was obliterated, Halsted and Bassini's original idea of the value of the transplantation of the cord still held good. Apparently the cure of inguinal hernia was accomplished before the deaths of Halsted and Bassini, and other surgeons of their age, whose names are associated with this endeavor.

Recurrences today must be largely due to the operator's ignorance or carelessness in following the steps of the operation that experience has proved essential to success.

Halsted, therefore, lived to see, and I hope to enjoy, as his associates did, many of the operative procedures he was largely responsible for become fundamental and accepted, and it will be many years before Halsted's name is not mentioned with hernia and the complete operation for cancer of the breast.

INTESTINAL SUTURE. SURGERY OF THE INTESTINES

Dr. Halsted was intensely interested in the details of intestinal suture from his experimental study in Welch's laboratory in 1886 up to his death. Most of his work was purely experimental. His original conceptions were practised chiefly on dogs, and most of them were successful. Unfortunately, when applied to man, they were not successful in Halsted's hands and very few of his associates practised his method of suture. When I visited Frederick Treves in London and we were discussing Halsted's intestinal suture, he remarked that this wonderful and original experimental work on dogs was, in his opinion, of no value for operations on man. When I told this to Halsted on my return I could see that his feelings were very much hurt. Nevertheless some ten years before his death, he voluntarily talked to me confidentially and expressed disappointment in his work both experimental and practical on intestinal suture.

I disagree with both Halsted and Treves. I am inclined to the opinion that as years go on more and more young operators will find Halsted's experimental work as reproduced in his *Surgical Papers* (vol. 1) fundamental, and not only the very best among the earliest studies, but still so at present. His descriptions and illustrations are characteristic of his originality and his attention to the gentle handling of tissue and the most perfect anatomical approximation. He was the first to emphasize the importance of catching the mucosa with the needle, to bring to the attention of the surgical world the fine straight needle threaded with fine black silk and sterilized for operation. Halsted presents the early literature on intestinal suture, but unfortunately fails to refer to Billroth's experimental and practical work on resection of the stomach for cancer. Billroth employed three rows of interrupted sutures of silk, the third row approximating the mucous membrane. The Billroth 1 operation, suturing the duodenum to the open end of the stomach, is undoubtedly the most difficult end-to-end anastomosis. When applied to the human gut, Halsted's one row of mattress sutures is insufficient. When two or three rows of mattress sutures are employed, too much is turned in. However, when one adopts Billroth's idea of three rows of interrupted sutures of the so-called Lembert type and Halsted's fine black silk threaded in his fine straight needle or the fine French curved needle, one has the most successful intestinal suture which will meet and overcome all difficulties no matter where it is applied. Halsted, as stated before, abhorred catgut and as far as I know, never used it in intestinal suture. We have, however, developed a perfect aseptic catgut which can be impregnated with chromic acid. The finer strands are strong. Catgut is now prepared threaded for continuous suture. It has its distinct place in intestinal suture, especially for the mucous membrane. Nevertheless, in my own experience, I still employ the fine black silk and needles of Halsted and usually the three rows of interrupted sutures of Billroth.

Now and then the specially prepared threaded catgut is used for the mucous membrane.

When Halsted was employing his method of suture

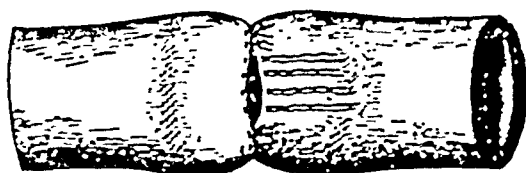


FIG. 10. Sketch of Halsted's end-to-end suture with single row of mattress or quilt stitches.

many surgeons were still using for an anastomosis Senn's decalcified bone plates, or rubber rings. During my student days at the University of Pennsylvania in Professor Reichert's physiological laboratory, with my classmate Hiller, we performed all types of intestinal anastomosis and suture, but never got beyond the rough methods of bone plates, rubber rings or potato rings. Then I knew nothing of the literature beyond Senn's experimental work. Murphy of Chicago, a man of most original mind and operative ability, was influenced by neither Billroth's nor Halsted's work on intestinal suture, but originated a substitute in his button, and for many years a number of operators preferred the button and feared the suture. Today intestinal suture is a pretty well-established and successful procedure, but I urge all who may read this to turn back and study Halsted's original work.

The most remarkable finding in Halsted's writings on suture of the intestine, from beginning to end, is his fear of soiling. As a matter of fact, judging from my experience on dogs and man, the danger of soiling during the operation is insignificant as compared with the danger of a leak from a faulty suture or obstruction from too much inversion in any anastomosis. Halsted emphasized from the very beginning the importance of not injuring in any way the circulation of the gut. Figure 10¹ demonstrates the single row of quilt or mattress sutures, Figure

¹ Fig. 21, vol. i, p. 205.

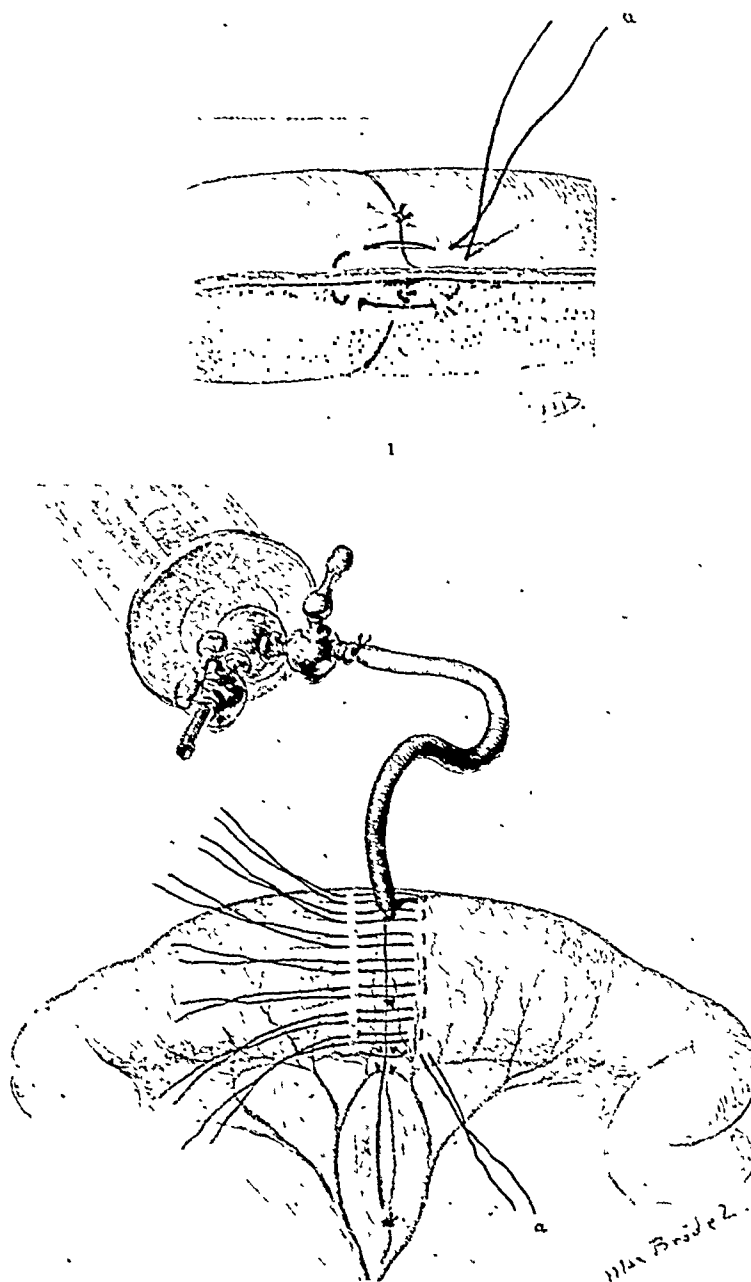


FIG. 11. Halsted's end-to-end anastomosis with inflatable rubber cylinder.

12¹ the method of a single row of mattress sutures applied to lateral anastomosis. Figure 11² shows Halsted's end-to-end anastomosis with an inflatable rubber cylinder. This method

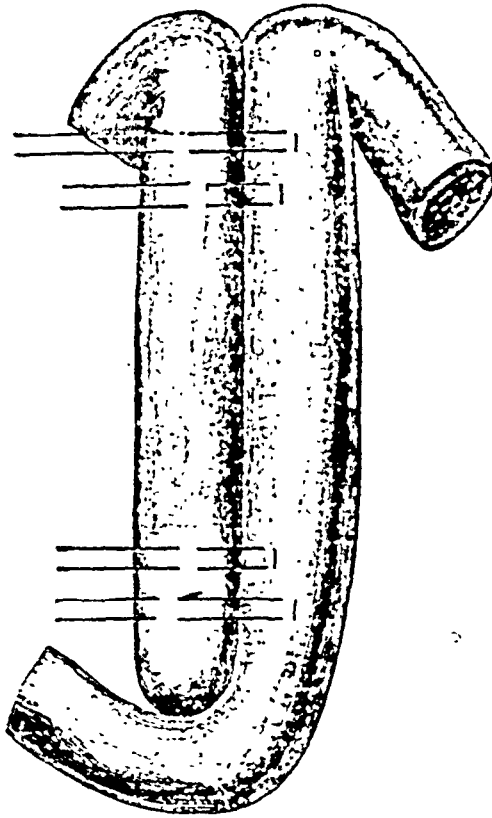


FIG. 12. Halsted's method of lateral anastomosis with a single row of mattress sutures, the same as he employed in gastroenterostomy.

was presented to the medical society in 1897. I had the good fortune to employ it successfully in 1898 after resection of a piece of gangrenous ileum strangulated in the sac of an inguinal hernia. But even then I used three rows of interrupted fine black silk instead of one row of mattress sutures. Later Halsted developed his bulkhead sutures of the intestine that

¹ Fig. 25, p. 214.

² Pl. XI, 2.

may ultimately prove very important when we must resect the lower sigmoid and upper rectum. I always keep Halsted's instruments in the operating room for this procedure, but so far there has been no opportunity to employ them. The success of the new type of lateral sigmoid colostomy combined with appendicostomy has influenced me not to take the added risk of an attempt to restore the continuity of the bowel by end-to-end suture after resection of cancer in the lower sigmoid and upper rectum, but I look forward to the day when cases of this kind will come under observation with much smaller tumors and we will again consider restoration of the function of the bowel.

In conclusion I urge all surgeons not familiar with Halsted's work on intestinal suture to turn to the Surgical Papers (vol. 1) to study the illustrations most carefully and read minutely what he has written. Remember, that most of this was conceived and done more than forty years ago. It ranks therefore with the original work of Billroth which antedated Halsted's only a few years.

HALSTED AS AN EVIDENCE OF THE VALUE OF THE SURGICAL SPECIALTIES

I am not writing this either to praise or to criticise Halsted, nor as I said in the introduction, as an historical paper. It has a definite purpose, an attempt to record as clearly and as briefly as possible the original conceptions and achievements of Halsted as an operator, a diagnostician, a surgical pathological, and a laboratory experimenter, and I have chosen those which in my opinion are still of fundamental value to members of the medical profession today, especially to the surgical group.

Halsted's achievement in resection of the stomach and colon and intestinal suture are evidence of the difficulty and perhaps the impossibility of a single individual being proficient in all departments of surgical diagnosis and intervention. When Halsted operated upon a lesion of the stomach or colon he was not as successful as in other fields. It may be difficult to

explain the cause but the fact remains true. All of his associates will agree with me, especially Finney, who without the training of the experimental work in the laboratory, almost immediately mastered the difficulties in the various operations upon the stomach, colon, and intestines, and his name will always remain as an originator of one of the fundamental operations upon the stomach and duodenum: Finney pyloroplasty. The impossibility, therefore, as illustrated by an individual of Halsted's mental character of becoming what we might call a great and universal general surgeon, is clear evidence that surgical specialities are a proper development in the evolutionary progress of surgery. Every reader who has seen the great masters in surgery operate or attempt to operate outside of their special field will agree with this statement. I witnessed this in Vienna in 1893 when Billroth attempted to use Bigelow's apparatus to crush a large stone in the urinary bladder. I was also present at the autopsy next day. The rapid development from general surgery of such specialities as neurological and urological surgery and during the war, plastic surgery, is convincing evidence. William S. Halsted was a splendid example of the necessity of specialism if one wishes to be a master in the science and art of surgery. The same is becoming true of pathologists, especially in the newer demands of surgical pathology for diagnosis of frozen sections from tissue obtained in the operating room. No matter how expert one may be in the recognition of curettings from the uterus, or excised pieces of the cervix, this does not help much in the differentiation in the microscopic section of a benign from a malignant tumor of the breast, nor does the knowledge of the microscopic pathology of the breast help in the microscopic differential diagnosis of lesions of bone.

This difficulty of becoming an expert in diagnosis and therapy is becoming greater in spite of the better fundamental education before graduation in medicine and the larger opportunity in hospital clinics and scientific laboratories after graduation.

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It is to be remembered that Halsted quoted Shuh, that it would be worth while to become a surgeon and devote an entire life to the service of discovering the operative cure of inguinal hernia.

APPENDICITIS

It is unexplainable why Halsted has written so little about appendicitis. In his Surgical Papers there is but one reference, entitled *A Diagnostic Sign of Appendicitis*.^{*} He presented a case to the medical society in 1893. The diagnostic sign is described by Halsted as follows: "When one can not press with the fingers into the false pelvis on the affected side so deeply as on the healthy side, in the earliest stages it is a spasm of the muscle which prevents one from dipping in the iliac fossa." He makes another interesting statement: "This muscle spasm may be partially or wholly eliminated by the proper application of the Paquelin cautery. When the patient is fully anesthetized no trace of the spasm remains."

It is to be borne in mind that at the opening of the Johns Hopkins Hospital in 1889 very few surgeons had had much experience with the diagnosis of appendicitis previous to the stage of abscess or peritonitis. When a case of appendicitis was fortunate to reach the stage of abscess without peritonitis, the drainage of the abscess was usually an insignificant affair, and the majority of surgeons made no search for the appendix. In the beginning peritonitis was a pretty hopeless affair, and when peritonitis came under observation earlier, recoveries were observed. Many surgeons concluded that the recoveries were due to their method of treatment, such as the Trendelenburg position or the Fowler position, or the giving of salt per rectum, when, as a matter of fact, the recovery depended upon the earliest stage of the general peritonitis, the type of organism, and the removal of the cause. In 1894 Halsted, after opening the abdomen, and revealing general peritonitis, placed the patient in a tub of water at the temperature of 100°

^{*} Vol. 1, p. 222.

and in this way washed out the abdominal cavity. There were no recoveries, and there were no further attempts.

In my opinion Halsted's greatest contributions to the problem of appendicitis were, first, diagnostic, in the detection of muscle spasm; second, operative, in developing proper drainage for the local peritonitis and for walling off the infected area by iodoformized gauze. He writes:

A point of great importance in the operative treatment of these cases and one to which we give perhaps an unusual amount of attention is the packing off of the uninfected portion of the abdominal cavity from the infected portion prior to the opening of the abscess however small this abscess may be. And even when we believe there is no abscess, we pack off the general cavity with just as much care prior to the separation of the adhesions which glue the cecum to the parietal peritoneum; and, in the absence of such adhesions, prior to the separation of the adhesions which bind down the appendix. Should pus be present, it is carefully caught and disposed of in such a way that there is perhaps the least possible danger of infecting the general peritoneal cavity. I fear that I can not well describe to you our method of packing off and protecting the general peritoneal cavity. We use a good many sponges of gauze superimposed upon each other in such a way that should the innermost become soiled the outermost remain clean. It is well if possible to so pack the outermost strips of gauze that they may remain undisturbed and form a part of the final packing of the wound.

It is interesting to note that this was written in December 1893, three and one-half years after the opening of the hospital, and Dr. Halsted mentions about 48 cases of appendicitis; 9 hopeless cases of peritonitis fatal; 5 of less desperate peritonitis with recovery; 34 cases of appendicitis without general peritonitis with recovery.

My memory tells me that Halsted was largely responsible for teaching us the diagnosis of the early stage of appendicitis and this method of drainage. Later it was difficult for us to teach our associates in the hospital how to drain in the late stages of appendicitis, because as the years passed drainage for acute appendicitis became a very rare occurrence. It is my opinion that Dr. James F. Mitchell of Washington who

followed Harvey Cushing as Halsted's resident surgeon, had the largest experience of us all during his residency in draining for the later stages of appendicitis, and I hope he will corroborate this statement of the great value of Halsted's ideas and practices in this drainage.

In addition to the best drainage, Halsted also had in mind an incision and a closure which would be best to prevent post-operative hernia. Halsted never adopted the McBurney method of muscle splitting. He either cut the lateral muscles directly, or split the rectus muscle. Nor did he adopt the Weir modification of McBurney's procedure nor the Lenander incision which went through the rectus sheath. Apparently this muscle division in the lateral muscles or splitting of the rectus made an abdominal wound just as good for drainage and better for the healing which would lower the percentage of postoperative herniae. Halsted also employed silver wire sutures through the entire thickness of the abdominal wall in cases in which there was drainage. My experience at that time and since assures me that this is an important safeguard procedure. It is not necessary in all cases. If there is any doubt it is better to employ it.

I feel under obligations to Halsted for his instruction in the early diagnosis of appendicitis, in the most successful drainage, and a closure of the wound that limited as much as possible the probability of a hernia.

I have already mentioned Halsted's fear, which was not founded on the facts, of the danger of leakage during intestinal suture. Halsted, on the whole, was a very venturesome surgeon, but he attempted in every way to reduce the risks of every operative procedure, an attitude that was not characteristic of the majority of the so-called great surgeons of his time. But Halsted also was timid in some regions and in some operative procedures, and it was very difficult to explain these occasional fears and unusual timidity. This was shown in the removal of appendices between attacks and in the earliest hours of an acute attack when there was no infection outside

the appendix. In those early days most surgeons removed the appendix after the method attributed to Nicolas Senn of Milwaukee. The vessels were ligated and the appendix was ligated near the cecum, leaving a short stump. The mucous membrane was touched with pure carbolic acid and scraped out with a knife. The peritoneum was protected with wet salt sponges. We did not know the value of alcohol then. Then Halsted drained to the stump in spite of the fact that he did not believe in drainage of other clean wounds. Recollect, in those early times there were very few operations for appendicitis in the interval or in the earliest stages when the peritoneum was clean. Finney was the first at Johns Hopkins to invert the stump of the appendix by a suture of the cecum and to close the wound without drainage. Later this method was adopted by Halsted.

SURGERY OF THE BILIARY TRACTS AND THE PANCREAS

It was my good fortune to be associated with Halsted as resident surgeon in his department when he developed the principles of gall-bladder surgery—chiefly drainage of the infected gall bladder with or without stone and the removal of stone from the common duct and the handling of acute pancreatitis. Most of these problems were successfully worked out by Halsted with very little help from the literature. In this country up to 1896 and 1897 F. Lange of New York and Fenger of Chicago were perhaps giving the best and most attention to surgery of the gall bladder. Kehr was looked upon as the greatest authority in Germany. The Mayo brothers, Robson and Moynihan came into the picture later with the development of cholecystectomy.

Yet, Halsted contributed nothing until 1896 and then only a very short discussion of the remarkable paper by Lange delivered before the medical society at Johns Hopkins Hospital in October 1896. I remember very distinctly Lange's paper. He really gave in detail his personal experience, case by case,

and I was impressed with the fact of the great similarity with our experience at Johns Hopkins Hospital and how in many points there was agreement between Halsted and Lange. Halsted's remarks were very short; they had to be, because Lange's talk was very long. Halsted should have used this opportunity to rewrite the paper.

It is my conviction that Halsted's method of drainage of the gall bladder ranks first with the avoidance of postoperative hernia. Later postoperative hernia after drainage of the gall bladder became a very common occurrence, and even today I observe it after the simpler drainage when the gall bladder has been removed. Postoperative hernia after gall-bladder operations with drainage can be avoided just as certainly as in operations without drainage. It depends upon, first, the prevention of any leakage of bile and, second, upon the proper suture of the wound: strong silver wire passed through all the layers except the peritoneum meet the requirements best. The peritoneum can be closed separately and the layers of muscle and fascia can be neatly approximated separately, but it is far safer to add the through-and-through silver-wire sutures.

During my visit to Europe in 1892-1893 I made careful notes on the closure of all laparotomy wounds. At that time most of the abdominal surgery was performed for lesions of the pelvis. Among the leading gynecologists in every country in Europe very few depended upon catgut only. Most of them, in addition to the closure with buried sutures, reinforced with silkworm gut or heavy silk passed through and through and often tied on gauze plugs. Apparently they all feared, first, the breakdown of the abdominal wound with the evisceration of intestines, or, later, hernia. When I returned to this country I became familiar almost at once with the fact that those clinics which practised closure of the laparotomy wound with catgut only, even when chromicized, had a number of cases in which the wounds opened on the eighth to the fifteenth day, and to save the patients' lives the intestines had to be pushed back and the wound closed. There were some fatalities.

I record here again that in Halsted's clinic in which we followed his method of the closure of the abdominal wound there were no such occurrences. When there was no drainage Halsted, as in hernia operations, employed buried silk, later buried silver wire. When there was drainage, he used in addition silver wire through and through. There was a certain percentage of stitch sinuses before the employment of gloves, less with silver than with silk. But there were no early breakdowns of the wounds with evisceration of the intestines, no postoperative herniae after gall-bladder operations, and only a few, small, herniae in the drainage area after operations for appendicitis requiring drainage. The first laparotomy that I closed with catgut throughout in St. Agnes Hospital in about 1906 resulted in the breakdown of the wound on the fifteenth day. Fortunately I was present and the secondary suture with silver wire could be performed at once in the room of the patient. Later I had a similar case at Johns Hopkins Hospital. This has never occurred in my hands before or since. Of course, today our catgut is more dependable, but when wounds must be drained the additional precaution of silver wire passed through all tissues except the peritoneum seems to be a certain preventive and should not be neglected in special cases.

As far as I know this statement has never been recorded before. Later I may have an opportunity to give in detail the evidence of my claim that Halsted's original method of the closure of all abdominal wounds with or without drainage is still the best, although it may not be necessary in all cases.

In draining the gall bladder, Halsted sutured a rubber tube of good size into the gall bladder with silk and pulled the ends of the silk out of the wound. He then surrounded the tube and fundus of the gall bladder with iodoformized gauze, but the gauze entered the peritoneal cavity not more than 1 cm. The object was to prevent any leakage of bile into the peritoneal cavity or into the wound, and the tube and the gauze were left in place for more than ten days.

In the discussion of Lange's paper in October, 1896 Halsted speaks of three consecutive successful cases of incision into the common duct and removal of gallstones, but although this paper was read before the medical society it was never published. Halsted repeats here what he frequently told me: that he performed his first gallstone operation in 1880. This places Halsted as one of the first operators in this country to operate upon the gall bladder. He then discussed with Lange the question of drainage and the kind of drainage after removal of a stone from the common duct. He also cautions against the too early removal of the drainage. He advocates the suture of the duct after the removal of the stone and drainage to the suture rather than the introduction of the tube into the gall bladder. He speaks of the method of draining the gall bladder to prevent the leakage of bile which I have already discussed. He no longer followed Kehr's advice to operate upon the gall bladder in two stages.

It is interesting to record here a case in which Halsted was influenced by Kehr's advice to operate in two stages. I assisted him in 1894. It was a very easy simple case. The gall bladder was packed with a few large stones; there were no adhesions. Yet Halsted sutured the gall bladder to the peritoneum, packed down to this area and closed the wound. The wound healed so solidly that the stones could not be removed. For this reason Dr. Halsted sent the patient to Kehr. Kehr removed the stones and drained and later, for the first time Halsted operated upon a postoperative hernia in this region. It was this experience that influenced Halsted to be satisfied with his own technique, and it was the last operation for gallstones in two stages at Johns Hopkins Hospital.

The next contribution was in 1897 in which Halsted shows his great ingenuity in the conception of miniature hammers to aid in the suture of the common bile duct after the removal of a stone. Figure 13 portrays the hammer and its use. This method was ultimately given up. Further experience demonstrated the

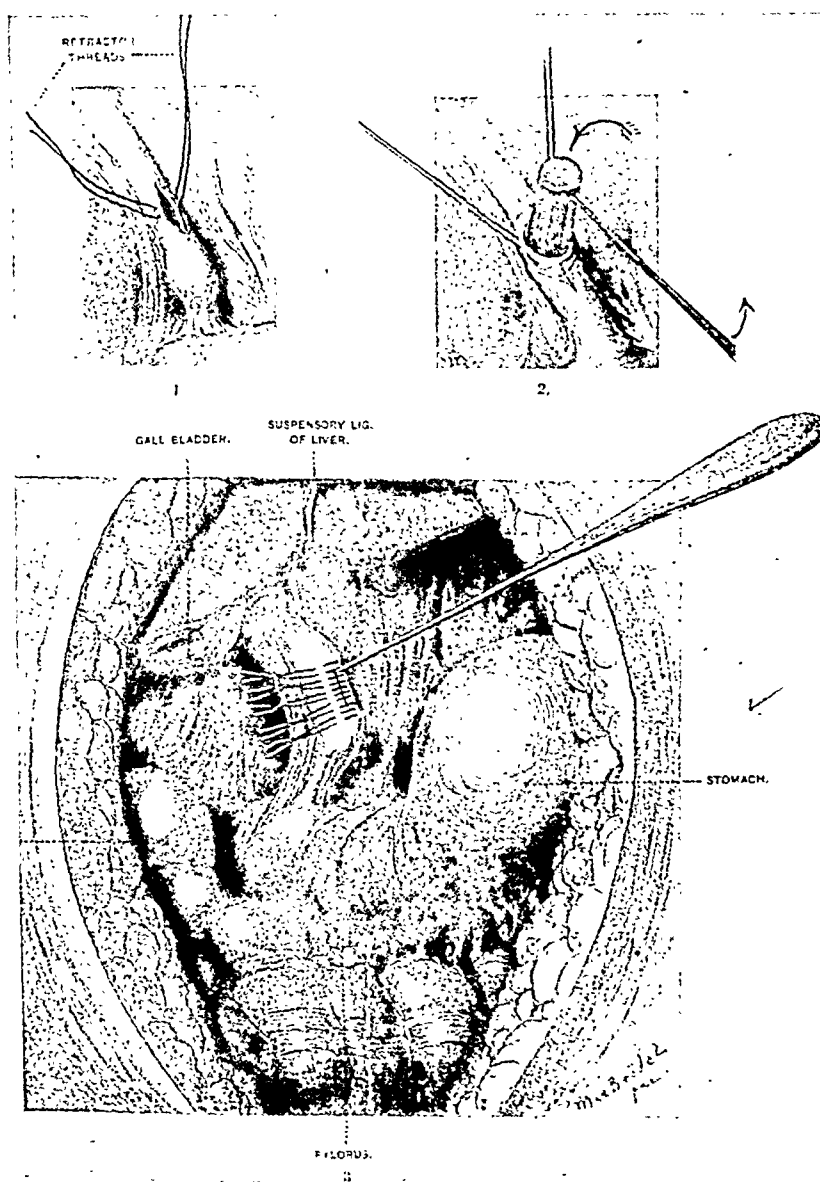


FIG. 13. The employment of the hammer in the closure of the common duct.

value of the drainage of the common duct after the removal of the stone.

. One of the last contributions by Halsted to surgery of the common bile duct was the drainage of the duct through the end of the cystic duct after the removal of the gall bladder. This method reduces the danger of leakage of bile.

Halsted was one of the first to operate upon a case of acute hemorrhagic pancreatitis in which the patient recovered. This patient was seen by Dr. Osler in the examining room of the hospital in 1890. He had been ill three days with vomiting and abdominal distention. He looked so ill and cyanotic that Dr. Osler himself accompanied him to the operating room. The diagnosis was intestinal obstruction. Dr. Halsted opened the peritoneal cavity in the mid-line finally from ensiform to pubes. He evacuated large quantities of blood-stained fluid. There was no peritonitis and no obstruction, but in the omentum there were definite particles of fat necrosis. Apparently both Halsted and Osler were familiar with this rare disease which Fitz of Boston had described some years before. I saw an autopsy with Formad in Philadelphia in 1889 and then became familiar with hemorrhagic pancreatitis and fat necroses. Halsted left no personal note on this case, and he did not recollect whether he explored the pancreas and gall bladder. Finding no obstruction and only evidence of fat necrosis, both he and Osler looked upon the condition as hopeless. When Halsted closed the wound hurriedly he remarked that we would soon have an autopsy. This patient is employed as a painter in Johns Hopkins Hospital today. He has never had an attack since. He has never been overweight, nor confessed to overindulgence in alcohol.

From the very beginning Halsted was interested in the pancreas in relation to gall-bladder disease, familiarized himself most particularly with all the literature and with Dr. Opie's experimental work. Unfortunately Halsted's writings on the surgery of the biliary tract and pancreas do not picture his great knowledge of the subject, nor his pioneer position in the

diagnosis and operative treatment. His writings give a slight glimpse of his original conception.

I have already recorded my opinion that Halsted's method of drainage of the gall bladder and closure of the abdominal wound should be considered a fundamental contribution. The same is true of his exposure and opening of the common duct, or the exploration of the duct, of passing a large probe through the diverticulum of Vater into the duodenum, and, first, of the drainage of the duct into the common duct itself and later, after removal of the gall bladder, the drainage of the common through the cystic duct. Halsted was slow in adopting cholecystectomy, and the importance of drainage of the pancreas through a rent in the gastrocolic omentum. It is to be recorded here that the gall bladders encountered in the early years of Halsted's surgical experience would be dangerous gall bladders to remove today. It is remarkable how few of these extensively diseased gall bladders which were so thoroughly drained by Halsted gave any further trouble. It is quite possible that many of them never functioned again, and that the mucous membrane was so destroyed that Luschka's secreting glands were obliterated. I made a most careful study of the results of Halsted's operations upon the gall bladder and the common duct up to 1900. The mortality was very low and the recurrences after drainage of the gall bladder very few. In a few instances second operations were performed for a second stone left behind in the common duct. All other common duct cases recovering from operation remained well.

SURGERY OF THE BLOOD VESSELS AND EXPERIMENTAL SURGERY OF THE LUNGS

Halsted has written more on this subject than on anything else. As he grew older, he gave more time to experimental surgery in the Hunterian laboratory and he devoted much attention to blood vessels, including aneurysms, intestinal suture and toxic goiter. In Volume 1 of his Surgical Papers 274 pages are devoted to blood vessel surgery, 152 to thyroid

problems. I can give no personal reminiscences of Halsted's experimental work on surgery of the blood vessels and surgery of the lungs. This came in a later period of his life. During my resident-surgeonship there was very little blood vessel surgery and there is only a single report. This operation, ligation of the first portion of the left subclavian artery and excision of a subclavial axillary aneurysm, was performed before I became a member of his clinic. However, I was present when Dr. Halsted presented this case. It was a very dramatic affair. Perhaps the most dramatic part was Welch's discussion. Halsted with his usual modesty, after presenting the patient fully recovered from the operation, left the room, and then Welch, whose remarks have not been preserved, spoke of Halsted as a surgeon in the very highest terms and how fortunate the Johns Hopkins Hospital was to have him as their chief surgeon. I do not believe Halsted ever performed a more difficult operation before or since. The aneurysm was huge. Halsted, however, was in his element, because the successful termination of the operation depended upon a slow, painstaking detailed procedure in which every bleeding point had to be tied. He could not aid himself by resecting the clavicle, because the aneurysm had eroded it, and there the sac was thin. Injury of the sac at that time would have meant death from hemorrhage. Finally, when the left subclavian artery was exposed it was entirely concealed by the subclavian vein. However, the operator, fully trained in this difficult procedure and familiar with the anatomy, succeeded in passing two silk ligatures to the artery as it emerged from the chest and divided the artery between the ligatures. This made the rest easy. The complete operation required three and one-half hours. Halsted writes: "This case is perhaps the only successful one of the ligation of the first portion of either subclavian artery and the first complete extirpation of the subclavio-axillary aneurysm. The patient lived many years."

Dr. Matas is one of the few living surgeons today who can really appreciate this great achievement of Halsted in 1892,

and also Dr. Matas is one of the few surgeons who can truly estimate Halsted's great contributions to surgery of the blood vessels.

SURGERY OF THE THYROID, PARATHYROID AND THYMUS GLANDS

These studies of Halsted began with experimental work in Welch's laboratory, and his contributions to this subject in pages rank second to his contributions to surgery of the blood vessels. In the beginning Dr. Halsted's experimental work in the laboratory before the opening of the hospital in 1889 was chiefly on intestinal suture and the thyroid. He continued his intestinal suture experimentation throughout life, later taking up blood vessel surgery. However, he never lost his interest in the thyroid, parathyroids and thymus. During my resident-surgeonship our time was so largely taken up with operative problems and, in the beginning of 1895, with teaching, that Dr. Halsted temporarily dropped his experimental work in the laboratory. In addition, the pathological laboratory became so crowded with special pathologists that there was practically no opportunity for experimental surgery, and when the Hunterian Laboratory was opened for Cushing and McCallum, Halsted had for the second time an opportunity for what he enjoyed most—experimental surgery. For this reason I can not speak personally of the experimental work even in later years. I assisted Dr. Halsted in all his early operations on the thyroid gland. The majority of the lesions of the thyroid were non-toxic goiters, cysts and adenomas. These offered no complications whatever, and Halsted's experience in axillary dissection prepared him for the most perfect attack on non-toxic goiters. This led to the development of a technique which was comparatively slow. During my period with Halsted there were not many toxic goiter cases and all of them were bad operative risks.

Halsted's experimental work ranks him with the first and best in developing our knowledge of the thyroid, parathyroids and thymus glands. The development of his technique for the

operation on toxic goiter came later when there were many others in the field.

HALSTED AS A PATHOLOGIST

Fortunately I had had the previous training and experience to appreciate Halsted as a pathologist. Because of this he gave me the great opportunity of taking charge of the pathological material from his operating room, of recording and studying it in a special room assigned to surgical pathology in Professor Welch's laboratory. When a student at the University of Wisconsin in 1886 I dined with Dr. Mackey in Milwaukee. After dinner he took me to his office and I witnessed him make a frozen section from a breast tumor removed by Nicholas Senn that morning. Mackey remarked, after cutting and staining the section: "I told Senn it was cancer," and added: "Fortunately, we did the complete operation." Mackey was educated in Edinburgh. It was the first frozen section I ever saw made, although I was quite familiar with the methods of making permanent sections, as I was taking a course of histology and embryology at the university. Later I witnessed Senn perform the complete operation for cancer of the breast which represented the most complete performed at that time. The muscles were not removed, the axilla was fairly well dissected out, the margin of skin given the visible and palpable tumor was small. The wound was closed without skin grafting. I soon learned that Mackey and Senn were good gross pathologists. Although Mackey's name does not appear, he aided Senn very much in the writing of his book on surgical pathology. Frozen sections were not made in the operating room.

In Philadelphia our greatest teacher of pathology was Formad and a few of us had great opportunities to familiarize ourselves with gross pathology from his autopsies. The professor of gynecology at the University of Pennsylvania always presented to special students of Formad the tumors of the ovaries and uterus which he removed at his weekly clinic.

The next week we presented before the class the microscopic reports from Formad's laboratory. In the majority of instances Dr. Goodell was right in his gross pathological diagnosis. He was the third surgical pathologist with whom I became acquainted. During my internship at the Children's Hospital in Philadelphia between 1891 and 1892 there were a great many autopsies on children.

I did not appreciate Halsted's remarkable pathological knowledge until I had returned from my extensive visits to European clinics. When I visited Vienna Billroth was living and engaged in active work and von Eiselsberg was his first assistant. Unfortunately I did not come in close enough contact with them to learn that Billroth was one of the great surgical pathologists.

I remember distinctly, and the records in the surgical pathological laboratory are evidence of these statements, that Halsted made very few mistakes in his gross pathological diagnosis at the operation. During my close association with him for seven years, we never used the frozen section to help us in the operating room. I had brought back from Europe a frozen section microtome and was familiar with making and staining the sections. This allowed us to see the sections more quickly after the operation to satisfy our curiosity, because then it took longer to get permanent sections. It is recorded in one of the surgical histories in 1891 that Dr. Halsted, after removing what he considered a benign tumor of the breast, sent it by an orderly to Dr. Welch in his pathological laboratory, some five minutes' walk away from the operating room. About three-quarters of an hour later Dr. Welch came to the operating room to tell Dr. Halsted that the section showed a benign tumor of the breast. But Halsted had already decided this from the gross appearances and had finished the operation and returned to his home before his colleague Dr. Welch had reached the operating room.

The first breast tumor that Dr. Halsted failed to recognize as malignant was a smooth-walled, thick-walled cyst contain-

ing blood. There was no evidence of a papilloma and no thick grumous material. It was the first blood cyst that Dr. Halsted had encountered in the breast, and no one then knew that such cysts are always malignant. We could not see any evidence of cancer in the wall. The malignancy was found a few days later in the section. The next blood cyst was recognized as malignant by Dr. Halsted. As long as Dr. Halsted lived and operated upon any case in which malignancy had to be considered, he retained his keenness of gross pathological diagnosis. There is also another evidence of his unusual training for the naked-eye appearance of pathological conditions, especially in the breast. During the first ten years of the experience in his clinic there were a few cases in which the breast tumor was clinically benign and when explored did not have the appearance of cancer of the breast with which Dr. Halsted was familiar. Therefore only the tumor was removed. Later, after careful microscopic study it was decided that the tumor was or might be malignant, and the complete operation followed. We now know that these tumors are not cancer and that Dr. Halsted's gross diagnosis of benignancy was correct, while the microscopic conclusion of malignancy was incorrect. Velpeau's experience confirms this. The first volume of Velpeau's book on diseases of the breast was written entirely on gross pathological diagnoses. In the second edition he complained that the microscope had led to many confusions. He did not realize, at least he did not comment upon the fact, that the individuals making the microscopic diagnosis were inexperienced, while he, Velpeau, had reached the zenith of gross pathological interpretation. Consequently Velpeau's microscopists frequently differed from Velpeau and the latter claimed that he was right. More than half a century later Dr. William H. Welch in a visit throughout this country was frequently called in consultation by operators who were good gross pathologists, because the less experienced microscopic pathologists found areas of malignancy in the myomas of the uterus which they had removed by hysterectomy; and the pathol-

ogist showed a tendency to diagnose encapsulated breast tumors and routine curettings from the uterus as malignant. In this personal communication to me Welch expressed the opinion that the experienced surgeons were always right.

We are approaching the period today when this great pathological knowledge and keen ability to distinguish the benign from the malignant at the exploratory operation is of fading value. The enlightened individual, due to modern educational methods, comes under observation in a much earlier stage of the disease, and until we have discovered a laboratory test, as for example a differential stain between the cell that is not cancer and the cell that is positive diagnosis is not always possible. Cancer has become a microscopic disease. If this generation can become just as proficient in the microscopic differentiation of diseases exposed in the operating room by the knife, as Halsted and the great surgical pathologists beginning with Velpeau were expert in the recognition of benign and malignant conditions by their naked-eye appearance, there will be very few mistakes of incomplete operations for malignancy when the lesion is operable or complete operations for non-malignant local growths. Apparently it is more difficult for an operator to be proficient in the operative technique and in microscopic diagnosis than it was for the operator to be proficient both in the operation and the naked-eye recognition of pathological conditions exposed during the operation or brought to view after removal of the mass. It may be ultimately just as necessary to have a trained special pathologist in the operating room as a surgical assistant, or an anesthetist, or someone trained to give blood transfusions when indicated.

CONCLUSIONS

In conclusion, I have attempted, largely from memory, but with Halsted's publications before me, to picture briefly Halsted's knowledge of the principles of surgery at about the time of 1894 or 1895, when I had had two years' experience

with him in the Johns Hopkins Hospital as his resident surgeon. For at least five years I assisted him as first assistant, made rounds with him, and became familiar with his diagnostic ability. Osler told me that Halsted was the best read of any member of the faculty. I soon learned that this reading was largely of German literature and at that time and for some years later it undoubtedly was the best surgical literature. The atmosphere of Johns Hopkins Hospital was strikingly different from anything in this country at that time. The four clinical professors were on comparatively large salaries. Their private practice, in the beginning, outside the hospital, was relatively insignificant. Although we were very busy, no one was hurried. I do not remember how Dr. Halsted got to the hospital. Frequently I rode in street cars to and from the hospital with Osler and Welch, or with Kelly in his open victoria and two horses. Halsted did drive a most disreputable looking horse and buggy, a great contrast with his equipment five years later when he had a liveried coachman, a cob horse and a most striking closed coupé. But this transportation was also very leisurely.

As an example of life in those early years, I may briefly tell this story:

In 1893 we were treating tuberculosis of the joints with injections of iodoform. About once a month, on Saturday afternoons at about half past two or three, Halsted called at the hospital with his very countrified horse and buggy, and we took the necessary things for anesthesia and the freshly boiled instruments and sterile towels wrapped in sterile sheets and packed them in the back of the buggy. The latter was rather dusty. We then drove slowly about ten miles to the country place of a Baltimore lawyer whose daughter had tuberculosis of the hip. I anesthetized the young girl and Halsted cleansed his hands and the area on the hip. I then unfolded the sterile sheet and Halsted picked up the hypodermic syringe which had been filled with the oil emulsion of iodoform and gave the injection. We rarely returned home before seven o'clock.

This procedure took more time than six or eight operations in the morning. It was a great intellectual treat for me, because I made it a point to ask Halsted questions every second, coming and going, and in those precious half days I was told in the most interesting way the entire history of Halsted's surgical work in New York and about all the New York surgeons. In addition, I learned the names of all the German surgeons connected with German universities and about their work. He also familiarized me with the great clinic in Vienna. The knowledge gained then was of the greatest value to me and put me in the position to realize Halsted's intellect and originality, and his unusually keen knowledge of medical and surgical affairs throughout the world. Later on life became more complicated and occasions of this kind less and less frequent.

I hope that some day I may write an appreciation of William Stewart Halsted which will somewhat approach the heights of the appreciation written by Rudolph Matas as an introduction to the Surgical Papers of Halsted. Dr. Matas tells us that his real familiarity with Halsted and his surgical knowledge did not begin until 1903. Therefore I have attempted here in a most brief way to describe those achievements of Halsted which are fundamental today and should be as valuable to the intern and young surgeon as they were to Halsted and his group of trained surgeons.

HYPERTROPHIC TUBERCULOSIS OF THE ILEUM WITH MULTIPLE LESIONS

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TUBERCULOUS enteritis, while not in itself a very rare disease, is usually invested with more medical than surgical interest. In its commonest form, ulcerative enterocolitis, it is a frequent concomitant of advanced pulmonary tuberculosis. Its incidence under such circumstance is variously placed at from 52 to 90 per cent, as based upon autopsy findings, in the reports of different authors. Rarely, if ever, is it a primary lesion in adults; almost universally it is considered secondary to some pulmonary, or possibly laryngeal focus. It is most common in children and young adults, various ages reported ranging from three to seventy-one years. The greatest incidence, however, seems to be between twenty and thirty years. It frequently affects the large bowel in the region of the cecum and ileocecal valve, although it may extend throughout its length.

When present in the small bowel, the terminal 4 feet of ileum are most often affected. Here lymphoid tissue is most abundant. It is rare to find the ulcerative process confined to the small intestine alone. The case which we report is of this type of which very few instances have been recorded to date.

Tuberculous lesions of the intestine are thought by some observers to be dependent upon (1) a blood-borne infection; (2) an implanted infection, from swallowed organisms; and (3) an extension from mesenteric glandular involvement. (The latter would seem to be rather a reversal of the expected progression.) The most likely etiological explanation seems to be the passage of the tubercle bacillus through the bowel

mucosa (which need not have been previously injured or diseased to furnish a portal of entry) into the lymphoid tissue in the submucosal layer of the bowel wall. Here the usual reaction of the tissues, which we recognize grossly and microscopically as tubercle formation, takes place, followed later by ulceration of the mucosal layer. Rarely does this process extend outwards into the muscularis and serosa, hence these tuberculous ulcers rarely, if ever, perforate the bowel wall. In some instances, where the individual's resistance is great enough, or the infection sufficiently attenuated, an attempt at repair is made. It is then that tuberculosis of the intestinal tract begins to assume surgical significance. To be sure, some surgeons have advocated certain procedures for the relief or cure of certain distressing symptoms of the disease, e.g. diarrhea, hemorrhage, obstruction, etc. Resection of the ulcer-bearing bowel has been proposed. Unfortunately the condition is usually too widespread and the patient in too bad condition physically, to stand an extensive operation. Loop exclusion, in order to give rest and a chance to heal, appeals to some, but the same objections hold, though to a less degree. With the advance in knowledge concerning the use of natural or artificial sunlight in the treatment of all types of tuberculous lesions, the need for surgery seems to grow less and less, until now it would seem that operation is rarely indicated in the purely ulcerative stage of tuberculous enteritis.

Coincident with the attempt at healing, one of two things may happen: (1) either a marked hypertrophy of the bowel wall, to the extent even of encroachment upon, or complete blockage of, the intestinal lumen, the so-called hypertrophic type; or (2), a gradual contraction of the fibrous scar tissue, with diminution of the lumen of greater or lesser extent, the so-called stricture forming type. The liability to repair-tissue overgrowth seems to be in inverse ratio to the virulence of the organism and to the degree of infection. Just as the ulcer-bearing area is usually in or near the ileocecal valve, so is this

the commonest area for hypertrophic manifestations and stricture formation.

With the encroachment upon the bowel lumen advancing to the point of partial obstruction, we have laid the foundation of a true surgical condition. While a few authors take the extreme position that no intestinal tuberculosis is rightly treated by surgery, that even the obstructing, hypertrophic types yield to efficient "light" treatment, there is almost universal agreement that here operation is justifiable, indeed, indicated. Especially would this seem to be the case, since admittedly, the hypertrophic type usually occurs in cases where there is either a mild pulmonary involvement, or one which appears to have been completely arrested.

The symptomatology of hypertrophic intestinal tuberculosis is that of any chronic partial intestinal obstruction, plus a definite or suspicious tuberculous infection. There is nothing characteristic enough to warrant positive differential diagnosis, but in a relatively large number of instances, a careful history will direct suspicion in this direction.

The operative procedure should in every instance be determined by the conditions encountered after the abdomen has been opened, taking into consideration the general physical condition of the patient.

The case which we report is of more than ordinary interest, and quite unique, in that a second resection of the ileum had to be made after a short interval, due to a rapid recurrence of the process. It was of the hypertrophic type, confined entirely to the ileum. Counseller states that only seven cases of this type had been reported in the literature up to 1929, though we have been able to find a few additional. There were multiple lesions present, two of which seemed to be of rather rapid development. There were two separate operations required, each with resection of involved loops of bowel. Other interesting points were the family background of tuberculosis, one brother and one sister having died of this disease, and the patient himself exhibiting signs of healed apical lesions.

though with a *negative* tuberculin reaction; the onset of symptoms following immediately upon a previous operation, performed elsewhere, for acute appendicitis; the course of the disease while under our own observation; and the excellent recovery, and satisfactory present condition, after eighteen months.

The case report follows:

Mr. J. L. C. C., male, white, aged forty-six years. Admitted to Union Memorial Hospital, Baltimore, January 9, 1929. Discharged May 2, 1929. Complaint: Periodic pain in left lower abdomen.

Family History: Father died at sixty-two, of diabetes; mother died at seventy-two, suddenly, cause unknown; one brother died at forty, and one sister at twenty-one, of tuberculosis; one sister died at thirty-nine, of erysipelas. Three sisters are alive and well at forty-four, fifty-two and fifty-four, respectively.

Marital: Married seventeen years. Wife alive and well at thirty-eight. One miscarriage, at three months, about fifteen years ago. One son alive and well at sixteen. No other pregnancies.

Occupation: Manager of a chemical plant, where ammonia and wood alcohol are made. Little exposure to fumes, however.

Past History: General health good. Childhood diseases. At eighteen years an attack of jaundice which lasted about ten days. In 1926, following loss of weight of 10 pounds, was subjected to period of biliary drainage by duodenal tube; weight regained following this. In October, 1928, appendectomy for acute appendicitis, with good recovery.

Review of Systems: Head, eyes, ears, nose and mouth negative. Cardio-respiratory: negative. Gastrointestinal: always poor appetite. Chronic constipation for seventeen years, for which a mild cathartic is taken each night. Genitourinary: negative. Nervous: negative. Skeletal: negative. Present weight 120 lbs. Normal about 140 lbs. Habits: Fairly regular meals, though small eater. Moderate use of tobacco and alcohol.

Present Illness: Ten days after leaving hospital following appendectomy, developed intermittent sharp, shooting pains in lower left abdomen, usually accompanied by nausea and vomiting. This was aggravated by nervous strain or exercise. The attacks have become gradually more severe and frequent, since the onset. They occur almost always in the evening or early night. Vomiting usually furnishes some relief from the pain. The attacks do not seem to come at any regular intervals, or to be induced by any particular thing. There has been no noticeable increase in the degree of chronic constipation, no periods of diarrhea, no abnormalities noted in the stools. There has been gradual progressive loss of weight.

Physical Examination: Rather markedly undernourished man, lying comfortably in bed. Skin sallow; no petechiae or eruptions. Mucous membranes fair color. No gross abnormalities. Bones and Joints: seem normal. Glands: anterior cervical groups moderately enlarged, epitrochlears not felt. Reflexes: present, active and equal. No Babinski reaction or clonus. Head: normal contour. No sinus or mastoid tenderness. Ears: normal. Eyes: pupils equal, regular. React to light and accommodation. Extraocular movements good. Ophthalmoscopic: normal. Nose: negative. Mouth: mucous membranes rather pale. Upper teeth gone. Remaining lowers show marked pyorrhea and are devitalized. Tonsils and Pharynx: negative. Neck: negative. Thyroid not enlarged. Thorax: symmetrical. Deep supraclavicular fossae. Respiratory excursions normal. Lungs: percussion note moderately impaired at both apices, to level of second vertebral spine behind. Prolongation of expiration, with increased intensity of whispered sounds over this area. No râles heard. Heart: apex in fifth interspace, inside the nipple line. Regular in force, rate and rhythm. No shocks or thrills. No murmurs heard. Blood-pressure 102/70. Radial arteries moderately thickened; radial pulse equal. Abdomen: symmetrical; rather scaphoid. Old well-healed McBurney scar. Respiratory excursions normal. No visible peristalsis. Liver not enlarged. Spleen and kidneys not felt. No acute tenderness anywhere. No masses felt. Percussion note normal. No hordoborgmus. Genitalia: normal. Rectal: negative. Impression: (1) Gastrointestinal neurosis with spastic colon. (2) Malnutrition. (3) Old fibroid tuberculosis at both apices.

Laboratory Examinations: Urine: specific gravity 1.010. Reaction: acid. Albumin: trace. Sugar: negative. Acetone: negative. Bile: negative. Microscopic: occasional hyaline cast and white blood corpuscle. Many urates. Stool (numerous examinations): little mucus. soft, dark brown, normal appearing. Occult blood usually present, though never marked. No gross blood. Bile present. Microscopic: negative. Blood: W.B.C. 13,300. P.M.N. 76 per cent. Lymphocytes 34 per cent. No abnormal cells. R.B.C. 3,830,000. Hemoglobin 75 per cent. Wassermann reaction: negative. Blood grouping iv. Chemistry: N.P.N. 17.6 mg. Sugar 93 mg. Gastric Analysis: Ewald meal: 112 c.c. recovered after forty-five minutes. Bile stained. Free HCl. 30. Total acidity 55. No occult blood. Microscopic: negative. Basal metabolic reading: -1. X-rays: bismuth enema. Entire colon filled except the cecum. Marked spasm of entire tract. Teeth: Marked pyorrhea. No abscesses. G.I. Series: Cow-horn stomach. Normal size. Good motility. No obstruction. Duodenal cap normal. No evidence of any lesion in stomach or duodenum. Colon prolapsed. Filled with barium in twelve-hour plate.

Progress Notes: January 10, 1929: This afternoon the patient had an attack of sharp, cramping pain in left lower quadrant. During the height of the pain, his face was drawn, and his body in a profuse cold perspiration. The entire abdomen was quite tense, most marked in left lower quadrant. There was little tenderness, and this not localized. Some complaint of nausea, but no vomiting. No visible peristalsis. Patient obtained almost immediate relief from benzyl benzoate dram 1. January 11: There was another attack of pain early this morning, which was partially relieved by self-induced vomiting, small amount. A return about noon was again controlled by benzyl benzoate. January 15: No further pain or discomfort during past four days. Patient sitting up. Appetite fair. Stools contain occult blood. January 16: Tuberculin test: 0.1 c.c. old tuberculin controlled with normal salt. January 20: Tuberculin test entirely negative. Patient continues to feel very well. Up and walking around. January 24: All remaining lower teeth were extracted this morning, at dentist's office, after mandibular injection. No reaction. January 26: For several hours this afternoon has had general discomfort, with some pain in left lower quadrant. Nothing very acute, however. This evening vomited 900 c.c. of greenish fermented fluid, without much relief of discomfort. January 27: During past twenty-four hours has vomited several times, a total of 2600 c.c. of fluid as above. Is feeling much better this evening. January 30: Comfortable for past three days. February 3: Has been having more discomfort for past forty-eight hours. Some nausea, but no vomiting until this evening, when there were 1800 c.c. of undigested food, at one time. Discomfort almost entirely relieved. February 6: Some abdominal pain and discomfort since last evening. This morning again vomited 1800 c.c., at one time, but without complete relief. February 7: Vomited 900 c.c. last night. Although nothing definite can be made out, and the patient gets along perfectly well in the intervals between attacks, it seems that there must be some organic obstruction somewhere. It is therefore deemed advisable to perform an exploratory operation.

First Operation: February 9, 1929. A thorough exploration was done through a mid-right rectus incision. The stomach and duodenum were normal in every respect. The gall-bladder was thin walled, blue, emptied readily; no stones were felt. Kidneys and spleen were normal to palpation. The colon was normal throughout, no constrictions or kinking. There were no particular adhesions in region of previous appendectomy. In the small intestine, about the junction of the jejunum and ileum, was an indurated area, about 2 inches in extent, practically completely surrounding the bowel, and markedly constricting the lumen. The peritoneum overlying this area was covered with enlarged lymphatics, no typical tubercle formation. The intestine was somewhat dilated for a short distance above the

mass. There were a few enlarged mesenteric glands. An 8 inch loop of intestine was resected, together with a wedge of mesentery containing the enlarged glands. A typical end-to-end anastomosis was performed, in two layers, the inner of plain catgut, the outer of silk. Wound closure, in layers, with catgut, and without drainage.

Postoperative Diagnosis: Indurated ulcer of small bowel, probably tuberculous.

Postoperative Progress Notes: February 9: Patient returned from operating room in good condition. Some nausea and vomiting. February 14: Course smooth and uneventful, except patient has required catheterization ever since operation until today, when he voided twice. Is taking soft nourishment and fluids well. No further nausea or vomiting since day after operation. February 21: Excellent progress during past week. A small abscess in the abdominal wound was opened this morning; contained small amount of typical colon bacillus pus. This evening patient complained of some abdominal cramps. This was accompanied by considerable nausea, and vomited a small amount of bile-stained mucus twice. Patient exceedingly apprehensive, due to similarity of this occurrence to that which followed his appendectomy. February 27: Wound well healed, infection cleared up. No further abdominal discomfort until this evening, when there was a recurrence of mild cramps across lower abdomen, with some nausea. Vomited once, undigested food. Bowels moving well. March 4: Fairly comfortable for several days until today, when there were rather severe abdominal cramps, some distention and borborigmus, nausea and vomiting. Patient very depressed mentally. March 9: For past several days patient has had intermittent vomiting attacks, bringing up as much as 800 c.c. at a time. Last night and today particularly uncomfortable with cramps across lower abdomen and pain through to back. March 11: Another very severe attack today, with much vomiting. For the first time there was definite visible peristalsis across lower abdomen, chiefly to left of midline and below umbilicus. Everything by mouth discontinued, infusion normal salt 2000 c.c., foot of bed elevated 6 inches, and hot stupes to abdomen. March 12: Much more comfortable, but slight elevation of temperature, 100° this evening. March 14: Attack has subsided, looks and feels much better. Temperature normal. No nausea. To have abdominal massage every other day. March 22: Excellent progress, up and around and on regular light diet again. Occasional slight cramps and nausea following massage, otherwise perfectly comfortable. Last night vomited undigested food twice. March 28: Still occasional twinges of pain across lower abdomen and through to back. Abdomen soft, no distention or tenderness. No further nausea or vomiting. April 4: Severe attack of cramps yesterday and today, accompanied by marked nausea and frequent vomiting, at

times as much as 1000 c.c. of bile-stained fluid, suggestive of duodenal contents. This afternoon there is again definite visible peristalsis, though an enema was fairly effectual, both as to flatus and fecal matter. April 8: Mild cramps and nausea at times. No more vomiting or visible peristalsis. Bowels moving adequately. April 11: Another severe attack of cramps, nausea and copious vomiting, and again visible peristalsis across lower abdomen. It was felt that there must be some intermittent partial obstruction, probably due to adhesions, or contraction of the previous anastomosis. An exploratory operation seemed to be indicated.

Second Operation: April 13, 1929: Old scar excised, and abdomen opened. There are a few adhesions of small bowel to under surface of scar; these were separated. Site of previous anastomosis is perfectly healed. There are two separate masses in the lower ileum, about 6 inches apart, with dilated loops of bowel above, and collapsed bowel below. The lower constriction is about 4 inches above the ileocecal valve, which appears to be normal. The peritoneum of the bowel over the masses is studded with typical small tubercles, and there are many enlarged mesenteric glands. Both large and small bowel elsewhere appears normal. No enlarged glands retroperitoneally along aorta; unable to find with certainty the site of the first anastomosis. The healing was so perfect. Resection of about 12 inches of bowel, down to within 2 inches of ileocecal valve, was performed. The stump was then inverted, and a typical lateral anastomosis, ileum to cecum, performed. The wound was closed with catgut and silk-worm gut, through and through stay sutures, without drainage.

Postoperative Diagnosis: Hypertrophic tuberculous constrictions, small bowel.

Postoperative Progress Notes: April 13: Patient returned from operating room in fair condition, moderately shocked. April 18: Progress excellent. No nausea or vomiting. Liquid diet. April 24: Patient making rapid, uneventful recovery. Wound well healed, all stitches removed. No infection. Is taking soft diet. Bowels moving well.

Discharge Note: May 2: Patient has made a remarkably rapid and uneventful recovery since last operation. No abdominal discomfort whatever. Wound solidly healed. On general light diet. Has been up walking around for several days and is rapidly regaining his strength. Weight is now back to within seven pounds of that on admission.

Follow-up: We have had several communications from the patient since leaving the hospital, all reporting satisfactory progress. He returned to work about six weeks after leaving the hospital, and has been leading a very active life ever since. He has regained his normal weight. Is keeping

out of doors as much as possible and taking systematic "sun baths." Now, after seventeen months, he feels perfectly well in every way.

Comment: There are a number of most interesting angles to this case, which furnish considerable food for thought. The patient was a nervous, rather high-strung individual. The complaints at first greatly outweighed any tangible objective signs or symptoms of organic disease. He was considered by his attending physician neurotic. There was the utter failure of all "special" examinations, except occult blood in the stools, to throw any light on the condition; x-rays, blood counts and chemistry, differential count, tuberculin reaction were all negative, hence the difficulty in making a diagnosis. The question arises as to the duration of the lesion; was it present at the time of the appendectomy in 1928? If so, was the appendix tuberculous? These questions cannot be answered as the operation was done elsewhere, and the specimen was not examined. Were all three lesions present from the beginning? Did the trouble in the lower ileum, found at our second operation, develop after our first operation? The latter would appear to be the case, as a thorough and careful exploration was made at the time of our first operation, and a note made as to negative findings. Such an examination should have revealed a pathological area in the bowel at the point where it was subsequently found, had one existed at the time. If it was not present at the first operation, it was quite remarkable that it should suddenly light up and develop with such rapidity, without any appreciable change in his general condition, or other evidence of renewed activity of his known, arrested pulmonary lesion. This case constitutes a very definite justification of the use of surgery in properly selected cases, and would also appear to furnish a refutation of the claims of those who take the extreme view that surgery has no place in the treatment of tuberculosis of the intestines.

Pathological report by Dr. Cohn: "In the gross we have a piece of ileum about 9 inches in length, much distended. On the peritoneal side we can see the constriction which extends almost around the bowel. It is

covered with a good deal of fibrous exudate. The wall of the ileum is considerably thickened. When we look at the mucous membrane side we can see that the lesion encircles the wall of the bowel and produces almost complete obstruction. The constriction is composed of a good deal of scar tissue and covered with mucous membrane, with here and there a minute ulcer. In the frozen section we can see a more or less normal mucosa, then an ulcer which is quite vascular and the base of the ulcer contains granulation tissue; in the granulation tissue we see a great many giant cells of the tuberculosis type, a tubercle formation with central giant cells, nothing suggesting malignancy."

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Also many other articles concerned only with tuberculosis of large bowel or of ileocecal valve.

CANCER OF THE RECTUM AND RECTOSIGMOID

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THE description of the pathological anatomy of cancer of the rectum and rectosigmoid as given by Mr. W. Ernest Miles¹ constitutes one of the classics of modern surgical literature. Nothing of importance has been left out. It forms a complete working foundation for rational treatment. Every surgeon of broad experience must recognize its accuracy. Everyone writing upon this subject must consciously or unconsciously draw heavily upon this document.

According to Miles, adenocarcinoma is the only type of cancer that is met with in the rectum. There are four clinical varieties: papilliferous, adenoid, colloid or mucoid, and melanotic. The papilliferous growth extends rapidly along the mucous membrane and soon involves the whole circumference of the bowel. It grows very rapidly and soon fills up the entire lumen of the bowel and produces obstruction. It is slow to infiltrate the muscles and is therefore one of the least malignant forms of carcinoma of the rectum. When seen early it is amenable to local treatment such as radium, actual cautery, or resection operation in which the sphincter may sometimes be preserved. The adenoid type is sessile, early involves the deeper structures and penetrates the muscles, enters the fat outside the rectum within the fascia propria and finally involves and penetrates the fascia propria and attaches to the pelvic wall and the organs and tissues surrounding the rectum. This is the common or usual variety of carcinoma of the rectum. The colloid or mucoid carcinoma is simply an advanced stage of the adenoid while the melanotic carcinoma partakes of the nature of melanotic tumors wherever found and is important in connection with treatment in that it is always fatal,

and therefore not amenable to any treatment other than palliative.

We may therefore devote most of our attention to the adenoid type of carcinoma which has been so well described by Miles as follows:

The great majority of cancers of the rectum are of this kind. They are usually seen as sessile tumors involving the mucosa and submucosa. In the majority of cases the growth is flattened, the transverse diameter being greater than the longitudinal. The tumor increases in size in all directions and though at first freely movable upon the muscular coat, soon infiltrates and becomes adherent to it. It is impossible to say how soon after the inception of the neoplasm deep infiltration takes place but probably it occurs within six months. As the growth increases in size, surface disintegration occurs and a definite ulcer, exhibiting the well-known malignant characters, is formed. Even at this early stage the retrorectal lymph glands are usually invaded, thus showing that extramural dissemination of cancer cells takes place while the growth is still in a clinically early stage of development. As more of the circumference of the bowel becomes involved, the ulcer deepens and assumes a crateriform appearance with nodular, everted, and indurated edges. When the ulcer has extended nearly all round the bowel, stenosis of the lumen is produced and then the stage is reached when symptoms of impending obstruction make themselves manifest. The adenoid cancer gives rise to extramural metastases which may be widespread while the growth is yet in an early stage clinically, and therefore must always be considered as highly malignant. It will inevitably recur after a restricted operation.

A carcinoma usually extends more rapidly in the circumference of the bowel than longitudinally as shown by the fact that a growth which extends entirely around may not be more than an inch or two in width from above downwards, even in the ampulla of the rectum. In the rectosigmoid where the intestine is surrounded by peritoneum, the growth entirely surrounds the bowel with a still narrower ring.

Miles has made some important observations as an estimate of the progress made in the advance of the growth of carcinoma. He estimates that it requires six months for the growth to travel one-fourth the way around the intestine and that about the same time is required for the lateral extension to fix the

mucosa to the muscular layers. He reports four cases in which he saw the growth in an early stage of development and in which the patients either refused operative treatment or were unable to submit to it for some reason or other. The growth in each of these patients when first seen was freely movable upon the subjacent muscular coat. At the expiration of a year after the first examination the extent of the circumference of the bowel which had become involved in each of the four cases was five-sixths, four-fifths, four-fifths, and three-fourths respectively. He, therefore, believes that when the growth has involved three-fourths of the circumference of the bowel, it has existed for at least eighteen months. Miles believes that the fascia propria is usually not involved until about this time. He is of the opinion that invasion of neighboring structures, such as the sacrum, uterus or vagina, prostate, or bladder, does not take place in less than a year after the first appearance of the objective symptoms or a year and a half after the incipency of the growth. He believes that if direct extension were the only means of spread of the growth, the surgical treatment of the disease would be quite simple and a local operation entailing nothing but the removal of the intestinal tube containing the cancer would be all that would be necessary to cure the patient. In this connection, he says: "Unfortunately, however, other and more important modes of spread take place simultaneously and with greater rapidity, leading to distant dissemination even when the primary growth is still in an early phase of development." He refers to the spread by means of the venous system and the lymphatic system. When the growth involves the venous radicles a mass of cancer cells may often be seen inside the lumen of the vein. When such an embolus of cancer cells breaks off, it may float down the portal vein and lodge in the liver. While Miles states that venous metastasis begins in the center of the right lobe, I have personally seen, in a number of instances, the only palpable liver growth in the left lobe. Liver metastasis is a late manifestation except in cases where treatment has

been given such as the local removal for biopsy, use of the cautery and more particularly radium. In a few cases where radium has been used some months prior to operation, I have later opened the abdomen with the intention of doing a radical operation. In every case of this kind, a metastatic nodule has been felt in the liver. Miles calls attention to the fact that if the right lobe of the liver is very large, even though there is no nodule on the surface, the enlargement is probably due to a metastasis in the center of the lobe, and is a late manifestation usually showing only in advanced stages of the disease. The usual method of spread of cancer is through the lymphatics. It is therefore important to study the anatomy of the lymphatic system. After doing so, one is convinced of the necessity of a radical operation.

Anatomists divide the rectal lymphatics into three groups: (1) The intramural lymphatics which lie in the wall of the bowel between its various layers. (2) The intermediary lymphatic system in which the lymphatics lie under the peritoneum and there form a so-called lymph sinus. Where there is no peritoneal investment, they lie in the perirectal fat. The lymph spaces around the intestines in this way serve as collecting stems from the intramuscular network of lymph vessels which empty directly into this lymph sinus. It is the belief of Miles that a detached cancer cell after entering this sinus may wander to any part of it before entering the extramural lymphatic system. (3) The extramural lymphatic system is the most important of all. The collecting stems from the lymph sinus enter into a relation with the lymphatic glands which are scattered over the surface of the rectum among the branches of the superior hemorrhoidal vessels. The efferents from this plexus and from the anorectal glands pass to their destination upward, downward or laterally.

Miles has paid particular attention to peritoneal involvement and believes that the pelvic peritoneum is especially liable to invasion. He has observed plaque deposits in the peritoneum of the pelvic floor in all segments from the middle

line to the brim of the true pelvis. The peritoneum is in close relationship with the lymphatic network situated between the levatores ani and pelvic fascia. He believes that it is essential that the peritoneum of the entire pelvic floor, as far as the brim of the true pelvis on both sides, should be removed in every case of extirpation of the cancerous rectum. In mentioning his early excision operations in which he excised the coccyx, removed a narrow strip of perianal skin, removed a scanty amount of ischiorectal fat and divided the levatores ani close to their attachments to the rectum, and severed the bowel an inch or so above the upper margin of the growth, recurrence ensued in every instance.

He then states:

By extending the scope of the operative procedure in successive series, I ultimately arrived at a removal which was the most complete that it was possible to carry out from the perineum. The type of operation was as follows: Preliminary colostomy, subsacral Kraske's or Bardenheuer's method of exposure; wide removal of perianal skin; free excision of the ischiorectal fat; complete removal of the rectum encased in its covering of fascia propria; removal of the lowermost part of the pelvic mesocolon together with the retrorectal glands; free incision of the pelvic peritoneum and the peritoneum of the pelvic mesocolon so as to permit of several inches of the pelvic colon being drawn down; section of the bowel at or near the middle of the loop. Although this type of operation was the most extensive that it was possible to carry out from the perineum, it did not suffice to reduce the recurrence rate to any appreciable extent, recurrence taking place in 94.4 per cent of the cases.

He believes that failure to prevent recurrence was due to the fact that tissues of the upward zone of spread, already invaded, lay beyond the reach of any operation carried out solely from the perineum. He believes that an attempt to excise a cancerous rectum from the perineum alone is as futile as amputating a breast affected by cancer without also clearing the axilla of invaded lymphatic glands.

With this conviction in mind, he planned a radical abdomino-perineal operation which was sufficiently extensive to

embrace the tissues of the zone of upward spread in addition to those of lateral and downward zones. By this means, he removed the whole of the pelvic colon and rectum encased in its sheath of fascia propria, the whole of the pelvic mesocolon, the peritoneum lining the floor as well as the walls of the true pelvis, the whole of the levator ani and coccygeus muscles, the external sphincter muscle, as much as possible of the ischio-rectal fat and a wide area of perianal skin.

While the operation was all done at one operation, it was divided into two stages. Through an abdominal incision, the sigmoid was severed high up, the sigmoid arteries and the terminal branch of the inferior mesenteric or superior hemorrhoidal artery ligated, the fat in the hollow of the sacrum mobilized, the peritoneum in the floor of the pelvis removed, the closed distal segment of the intestine dropped down and the cut edges of the peritoneum of the pelvic wall sewed together over it forming a diaphragm or new pelvic floor. Patient was then turned over, a larger area of perianal skin removed, coccyx, levator and sphincter muscles around the anus all removed with the rectum, after which the cavity was packed with gauze. The original description of the principles of this operation was published in *The Lancet*, December 12, 1908.

In 1912 W. J. Mayo² introduced the two-stage operation with the statement: "The combined abdominosacral operation in two stages has much to commend it and has a mortality of less than one-half that of the abdominoperineal operation in one stage." In this article he presented two methods of doing the two-stage operation. At the first stage, he did a simple colostomy. A week or two later the Kraske operation was performed from below leaving a closed end of the sigmoid below the colostomy. This was the operation which is known today as the posterior resection and is practically the same operation as that used by Lockhart-Mummery referred to in his report of cases later in this article. His second operation which was recommended for cases in which the growth extends high in the lower sigmoid was as follows:

A midline incision is made suprapubically, the exploration completed, and the sigmoid brought up and divided between two ligatures and both ends sterilized. The distal end is invaginated into the bowel with a purse-string suture, and the superior rectal artery tied. The mesosigmoid is divided above the promontory of the sacrum, the peritoneum divided on each side as far as the bottom of Douglas' pouch, and the fat and glands separated from their posterior attachments to this point only. The distal end of the sigmoid with the attached fat and glands is depressed and the peritoneum closed down and over the top of the mass. The anterior peritoneal attachments to the bladder and the lateral attachments of the rectum and lower sigmoid are not disturbed because the main blood supply through the superior rectal vessel has already been cut off. The end of the proximal sigmoid is brought out through the middle of the left rectus muscle as a permanent colostomy. A tube must be inserted into the lower fragment through the natural anus to carry off the discharges and to enable cleansing by gentle irrigation.

He then says: "This is an excellent method, but has an increased mortality over the method first described. It should not be practiced in the very obese, nor in those with obstruction. We had one patient die several days following the colostomy from perforation of the lower fragment."

Because of this danger of perforation reported by Dr. Mayo in his article, I set about to work out a plan to avoid this danger. This was accomplished by extending the abdominal part of the operation to include the separation of all the fat in the hollow of the sacrum down to the coccyx, after which the sutured end of the sigmoid was attached to a tube which had been previously passed into the rectum and which served to invert the sigmoid by pulling the severed end out through the anus. The peritoneum was then drawn across the raw surface in the pelvis and the abdomen closed (Fig. 1). This operation was described under the title, "The Major Procedure First in the Two-stage Operation for Relief of Cancer of the Rectum,"³ at which time 8 cases were reported. Of the 8 cases, the internal iliac arteries had been ligated in 4 cases as an additional safeguard in control of hemorrhage. In practically all the cases, local infection developed around the end of the sigmoid and a good deal of fever developed along with the

formation of pus in some cases. At the second stage of the operation, the last joint of the sacrum and the coccyx were removed. The local infection in some of these cases lasted for a

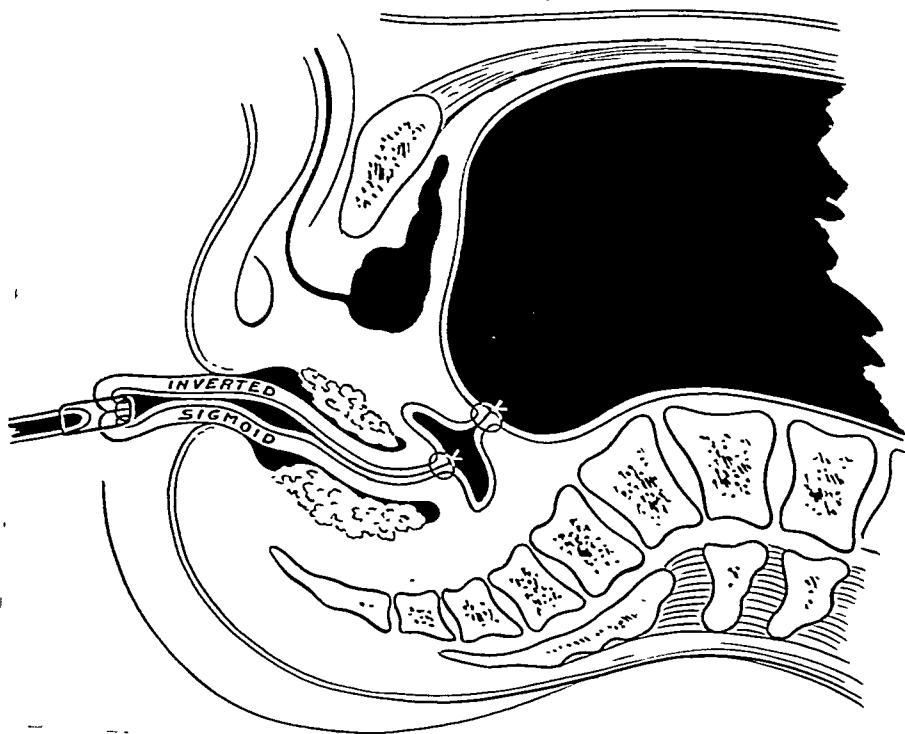


FIG. 1. Sectional view of sigmoid inverted and drawn out through the anus. Also the peritoneum sutured over end of inverted gut. (*Ann. Surg.*, April, 1915.)

week or two so that it was decided to drain through the abdominal incision in men and through the vagina in women. It was soon found possible to sew the peritoneum around the drain, thus making the drain practically extraperitoneal. A number of gauze wicks were used as a drain. Soon experience proved that still larger packages of gauze wicks gave better results so finally the operation used today was evolved. This operation was equally as radical as the Miles operation and being a two-stage operation gave a smaller mortality.

In 1915, Daniel Fiske Jones⁴ described a two-stage combined abdominosacral operation for carcinoma of the rectum. His operation is equally as radical as the preceding operations but involves quite a different procedure. The essential points as given by Jones are as follows:

1. The inferior mesenteric is tied high, and removed with the lymphatic channels accompanying it.
2. The sigmoid and rectum can be left in situ, after tying the inferior mesenteric and dissecting the pelvis, without fear of gangrene, as the vascular arches from the middle and left colic arteries *continued in the sigmoid arteries* are left in tact to supply the bowel.
3. A thorough dissection of the pelvis is made, including most of the lateral glands, into which some lymphatics of the rectum drain.
4. By closing the peritoneal flaps about the intestines, the second stage of the operation is entirely extraperitoneal.
5. The effect of sepsis is much diminished. The five days between the two stages seem to be sufficient to seal the lymphatics of the pelvis, which reduces the immediate effects of the infection.

The foregoing operations cover all the principles used in the modern operation for cancer of the rectum. It is the task of every surgeon to evaluate the importance of the various operations. In as much as each author is likely to be an enthusiastic advocate of his own operation, we must resort to comparative statistics to help us obtain a correct estimate.

STATISTICS

Statistics in surgical papers are usually introduced for the purpose of strengthening an argument. Many times, in the maze of an argument, the truth contained in statistics is obscured by eloquence. Someone, I believe it was Lord Moynihan, has said, "Anything may be proven by statistics, even the truth." It is sometimes easy enough to get the truth but not the whole truth. In giving an individual's statistics nothing short of the individual's entire experience is very valuable. A very striking bit of evidence of this point was shown in a paper published some years ago on "Chronic Peptic Ulcer," in which 471 cases were reported with a mortality of 4.2 per cent. Chronologically, from Case No. 213 to

Case No. 370, 157 consecutive cases operated upon, there was no death. In looking over the chronological table it was noted that Case 370 and Case 372 terminated fatally. The series of 157 operations without a death had no more statistical value than the series of three operations immediately following in which there were two deaths, giving a mortality in this latter series of $66\frac{2}{3}$ per cent. In cancer of the rectum, fortunately, we have several series of statistics which should have some value when all the series are compared.

In studying statistics, there are certain points which must be taken into consideration. (1), The general surgical ability or skill of the operator. (2) It must be appreciated that the originator of an operation, other things being equal, should do his special operation better than one who has not so carefully studied the principles. (3) Operability. Given two different series of 500 cases, constituting the entire number of patients seen and cases diagnosed, one surgeon operates upon 30 per cent, or 150 cases. Another surgeons operates upon 50 per cent, or 250 cases. It would be impossible to compare the results in the two series. It might be predicted that the first series would not have anything like the percentage of deaths and would have a much larger percentage of five and ten year cures. (4) Operators in the large centers where large charity hospitals exist, show better results with private cases than in their charity hospital cases. In the northwestern part of the United States where there are relatively few charity hospitals, the surgeon often operates at his own hospital where he must operate on the poor as well as the more prosperous patients. This condition would apply in such clinics as the Mayo Clinic and the Cleveland Clinic.

In studying end-results, it is the custom of authors to eliminate the cases which cannot be traced and assume the result would correspond to the ones which have been followed up. This probably leads to serious errors. It seems more than likely that a considerable percentage of these patients cannot be located because they are dead and therefore unable to

answer the follow-up letters personally and the family often has been scattered or has moved as a result of the death.

It would be most interesting to have the entire statistics of Miles but as far as I know such statistics are not available. In his own words, he⁵ gives the following statistics for his radical abdominoperineal operation:

My personal experience of the operation has extended to 72 cases, with the following results:

Operation Mortality		
First series.....	42 cases.....	40 per cent
Second series.....	19 cases.....	26.3 per cent
Third series.....	11 cases.....	18.1 per cent.

The decrease in the mortality rate has, I think, been due partly to improvement in technique and partly to the substitution of spinal anaesthesia with gas and oxygen for chloroform and ether.

Recurrence Mortality. Owing to having lost touch with cases during five years of war service I have been unable to trace the whereabouts of 17 of the 48 patients who survived the operation. Of the remaining 31, three died of intercurrent disease and eight died of recurrence. Leaving the 17 untraced cases out of consideration, the recurrence mortality works out at 28.5 per cent.

Cures. The following patients, known to be alive and well, may be regarded as cured—1 after eleven years, 1 after ten years, 4 after nine years, 3 after eight years, 3 after seven years, and 4 after six years.

In his latest paper he says:¹ "During the last two years I have adopted blood transfusion as a routine measure with the result that the mortality has fallen to 7.6 per cent." As to operability, he says out of 1200 cases he has operated upon slightly less than 400: exactly 32 per cent operability. He gives a series of cases from 1920 to 1925 for the purpose of showing the percentage of cures. He does not state in this series as to the number of deaths from operation, but simply gives the number of survivals as 94. Of these, 8 are untraced. Known to be alive and well, there are 69, or 73 per cent, five year cures.

The foregoing statistics are so incomplete and patchy as to have little scientific value as an indication of the results of the

Miles' operation. The fact that in 1200 cases seen, there was only 32 per cent operability, makes it impossible to compare Miles' statistics with the statistics of Jones who in a similar series of cases reports an operability of 53 per cent. The report of his early cases indicates a prohibitive mortality rate. During the last two years he reports an exceptionally small mortality rate. Two years is entirely too short a time to furnish reliable statistics. For example, in my series beginning in 1914, Case No. 8 died. There was then no death until Case 32, an interval in which there were 24 cases without mortality. The same objection may be raised to selecting a series of cases from 1920 to 1925 as a criterion for permanent results.

Lockhart-Mummery⁶ reports his total experience with 200 cases operated upon by the combined operation of colostomy and posterior resection in two stages. It is an interesting coincidence that he had exactly 100 private patients and an equal number of hospital patients. His mortality in his private cases was 3 per cent, while in the hospital cases it was 14 per cent, making an average of $8\frac{1}{2}$ per cent mortality for his entire series. He does not state the operability in his cases but gives quite a clear definition of the proportion of the various types of cases under three heads as follows:

"A: Very favorable cases where the growth was small and had not apparently invaded the muscular coat, and no glands were involved." Under this classification there were 73 cases. Of these 30 were traced for a period of five years; 22 were cured, 8 had recurrence, 73.7 per cent cured.

"B: Medium cases where there was involvement of the muscular coat but where the growth was not unduly fixed and there was no extensive involvement of glands." Under this classification there were 96 cases. Of these, 43 were traced for a period of five years; 19 were cured, 24 had recurrence, 44.1 per cent cured.

"C: Very bad cases, where the growth was large and fixed, or where there was evidence of extensive involvement of glands. These were borderline cases with a bad prognosis." Under this

classification there were 31 cases. Of these, 9 were traced for five years, 4 were cured, 5 had recurrence, 44.4 per cent cured. Nine traced cases out of 31 under this classification are entirely inadequate. It must at once be obvious that in a large series of cases under this classification, the recurrences would be much larger than in the preceding classes.

From the foregoing classification, it is very evident that Lockhart-Mummery's surgical cases have been selected very carefully from a large number of patients with cancer of the rectum. I am sure that not more than 10 per cent of patients with cancer of the rectum coming to the average surgeon for examination will fall under classification A. My own experience shows much less than 10 per cent. In this connection, it is well to quote from Lockhart-Mummery's conclusions:

That no statistics of this character are entirely satisfactory must be admitted, for they do not show the whole truth. The proper way in which such statistics should be worked out is to take, say, 500 consecutive cases of cancer presenting themselves for treatment, and show the number of cases operated upon, the operative mortality, and the percentage of cures, based on the original 500 cases. Such tables, if they could be worked out (as a matter of fact they cannot, as a large number of inoperable cases do not reach the surgeon at all), would form a useful guide as to the relative merits of different operative procedures. Unfortunately, they would show such a relatively low percentage of cures out of the total that they would be depressing reading. It is to earlier diagnosis that we must look for any material improvement in our cancer cures from operation.

Because of the obviously careful selection and consequent low operability, it would be impossible to compare Lockhart-Mummery's statistics with those of Jones who shows more than 50 per cent operability, but they are sufficiently accurate to show that Miles, with an operability of only 32 per cent, in reporting 94.4 per cent recurrences following a similar operation has probably based his conclusions on an inadequate number of cases.

In the Collected Papers of the Mayo Clinic for 1927, Rankin⁷ made a comprehensive report as follows:

TABLE I (Jones)
ALL RADICAL OPERATIONS

	No. Cases	Per Cent Died in Hospital	Operated Three Yrs.	Per Cent Living Three Yrs.	Operated Five Years	Per Cent Living Five Yrs.
Private	136	12.5	90	65.5	77	48
Hospital	132	33	68	66	61	47.5
Private and hospital	265	22.7	158	66	138	47.8

one and two stages and as a comparison the same figures for the combined abdominoperineal operation in one stage done under the best conditions, that is, in private practice. It will be seen that in properly selected cases the mortality in the one-stage operation is not high, and the percentage of three- and five-year cases is considerably higher than by any other operation. This is most gratifying and is conclusive proof, we believe, that the more extensive operation will give better results in those patients who can stand it than in those obtained from more limited operations. These are the statistics which should be compared with those of any other single operation, such as resection and suture, colostomy and posterior excision or any other single operation suggested for removal of cancer of the rectum.

TABLE II (Jones)
COMBINED ABDOMINOPERINEAL OPERATION—ONE AND TWO STAGES

	No. Cases	Died in Hospital Per Cent	Cases Operated 3 Yrs.	Per Cent Living	Cases Operated 5 Yrs.	Per Cent Living
M. G. H. & Private	204	22.7	120	70	103	50
Private.	102	11.7	67	71.6	56	53

COMBINED ABDOMINOPERINEAL OPERATION—ONE STAGE

Private	54	5.5	38	78.5	32	56
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In Table III will be found a comparison of the three important radical operations, the combined abdominoperineal operation in one and two stages and the colostomy and posterior excision. It will be seen that there is a gradual decrease in the cases living three and five years, from the abdominoperineal operation in one stage to a colostomy and posterior excision which suggests that the more extensive operation gives better results than the posterior excision. This is apparently denied by those who advocate the less extensive type of operation. It would indicate that the

more extensive operations should be carried out on those patients who are in sufficiently good condition to withstand the operation.

TABLE III (Jones)
END RESULTS
Abdominoperineal Operation—One Stage

No. Cases	Died in Hospital Per Cent	Lived 3 Yrs. Per Cent	Lived 5 Yrs. Per Cent	Untraced
93	17	73	53	2
Abdominoperineal Operation—Two Stages				
111	27	68	48	4
Colostomy and Posterior Excision				
61	22 8	50	40	1
Abdominoperineal Operation in One and Two Stages				
204	22 7	70	50	6

My personal experience is shown in the following tables, the first three of which represent the results of a follow-up survey

TABLE I (Total Cases as of May, 1928)

Total cases of carcinoma of the rectum and rectosigmoid operated upon from March, 1914 to May, 1928			152
Total patients not operated on.	Inoperable even for exploration .	13	24
	Refused operation	6	
	Went elsewhere	5	
Exploration and palliative operations.	Exploration .	12	49
	Colostomy with or without radium	32	
	Tube resection	1	
	Radium alone	4	
Radical removal	Rectum	25	79
	Rectosigmoid	24	
Radical removal	Rectosigmoid including obstructive cases	14	79
	Rectum . .	65	

TABLE II (Results of Operation with Inversion Technique)

Total cases operated upon.	65
Deaths from operation—4 mortality	6 15 per cent

made in May, 1928: rectosigmoid group includes all obstructive cases and includes a large per cent of the mortality of my series. Because of the inclusion of these obstructive cases, and the consequent high mortality, the three-stage operation has been adopted as a routine procedure for rectosigmoid cancer. Therefore, statistics in this group are omitted and only statistics on cancer of the rectum proper, in which it is possible to invert the sigmoid through the rectum will be included.

END RESULTS

In considering end results only five-year cures are included. Therefore, only those cases operated upon more than five years ago are studied. Total cases, 32; deaths, 2; mortality, 6.25 per cent. Of the 30 surviving operations, 3 have not been traced since operation. Six were traced and were well two years or more after operation since which time we have not been able to trace them. This leaves 21 cases for the study of end results.

TABLE III
END RESULTS IN 21 TRACED CASES

1. Patients dying before the expiration of five years.	8
Cause and date not known	1
Recurrence in liver, three and one-half years	1
Recurrence in liver three years	1
Cause not known, two years	1
Local recurrence of cancer, two years.	1
Local recurrence of cancer, twenty months	1
Local recurrence of cancer, seven months.	1
Recurrence in lung, eight months	1
2. Lived five years or more—(62 per cent)	13
3. Still alive and well.	8
Thirteen years; twelve years; six years, four months; six years, three months; six years, one month; five years, eleven months; five years, three months; and five years after operation.	
4. Patients dying after expiration of five years	5
Apoplexy, thirteen years	1
Pneumonia, six years	1
Local recurrence, six years.	1
Auto-accident, five years	1
Local recurrence, five years.	1

RECAPITULATION

In my first 32 cases there were 2 deaths (6.25 per cent). In my first 54 cases still 2 deaths (3.7 per cent). In 65 cases 4 deaths (6.15 per cent).

Taking into account the inaccuracy of such small statistics, it would seem fair to estimate that a death rate ranging from 5 to 10 per cent in the hands of skilled surgeons may be expected when this technique is used.

In 21 traced patients, 13 lived five years or more, 62 per cent five-year cures. Nine in a series of 30 is a large percentage of untraced patients.

Since May, 1928, when these statistics were prepared, 57 patients with cancer of the rectum and rectosigmoid have registered for diagnosis. Of these 10 were not treated either because they were inoperable even for exploration, went elsewhere, or refused operation; 21 cases were treated by colostomy with or without radium; 4 cases were treated by radium alone; 1 case was exploratory only; 9 cases of carcinoma of the rectosigmoid had the radical operation and 12 of carcinoma of the rectum had the radical operation.

TABLE IV

Total cases of carcinoma of the rectum and rectosigmoid...	209
Inoperable even for exploration, refused operation or went elsewhere.	34
Colostomy with or without radium..	53
Radium alone.....	8
Tube resection.....	1
Explorations.....	13
Radical removal	
Carcinoma of the rectosigmoid...	23
Hospital deaths.....	5
Mortality rate..	21.74 per cent
Carcinoma of the rectum, inversion technique.....	77
Hospital deaths.....	5
Mortality rate..	6.5 per cent
Total radical operations.....	100
Total number of hospital deaths.....	10
Percentage of hospital deaths.....	10
Operability for radical removal in the entire series of 209 cases.....	47.8 per cent

From the merging of this latter group of cases with the former statistics Table iv has been constructed.

Cancer of the rectum has in the past been placed in the category or borderline operability. Contrary to the established belief the above statistics indicate that, there are few parts of the body so favorably situated as the rectum for complete devascularization and removal of all the involved tissues in case of cancerous invasion. Most of the blood supply for the ampulla of the rectum and the rectosigmoid, as well as that of the connective tissue and fat found in the hollow of the sacrum, comes through one vessel, the superior hemorrhoidal artery. Most of the return circulation goes back through corresponding veins and these vessels are accompanied by the lymphatics, which together serve as almost the sole avenue for the spread of the disease upward. These vessels may all be included in a single ligature placed opposite or just below their crossing of the promontory of the sacrum in the mesosigmoid. It will be seen by the composite colored plate (Fig. 2) that this ligature at once severs the blood supply and the venous and lymphatic return circulation, thereby removing the danger of hemorrhage as well as upward metastasis during the further progress of the operation.

While it is true that some prefer the one-stage operation, I am very sure that the average operator, equally skilled in doing both the one-stage and the multiple-stage operation, will obtain better results with the multiple-stage. After a decision has been reached as to whether one-stage or a multiple-stage is preferable, the next question is what type of one-stage operation or what type of multiple-stage operation is to be used. In considering the one-stage operation, it would seem that Miles has so well met the demands of both anatomy and pathology that unless and until new and contradictory knowledge as to the nature and method of the spread of cancer has developed, no vital change can be made in the Miles operation. In short, any completely radical removal of the rectum and pelvic colon along with all other tissues involved in connection with cancer

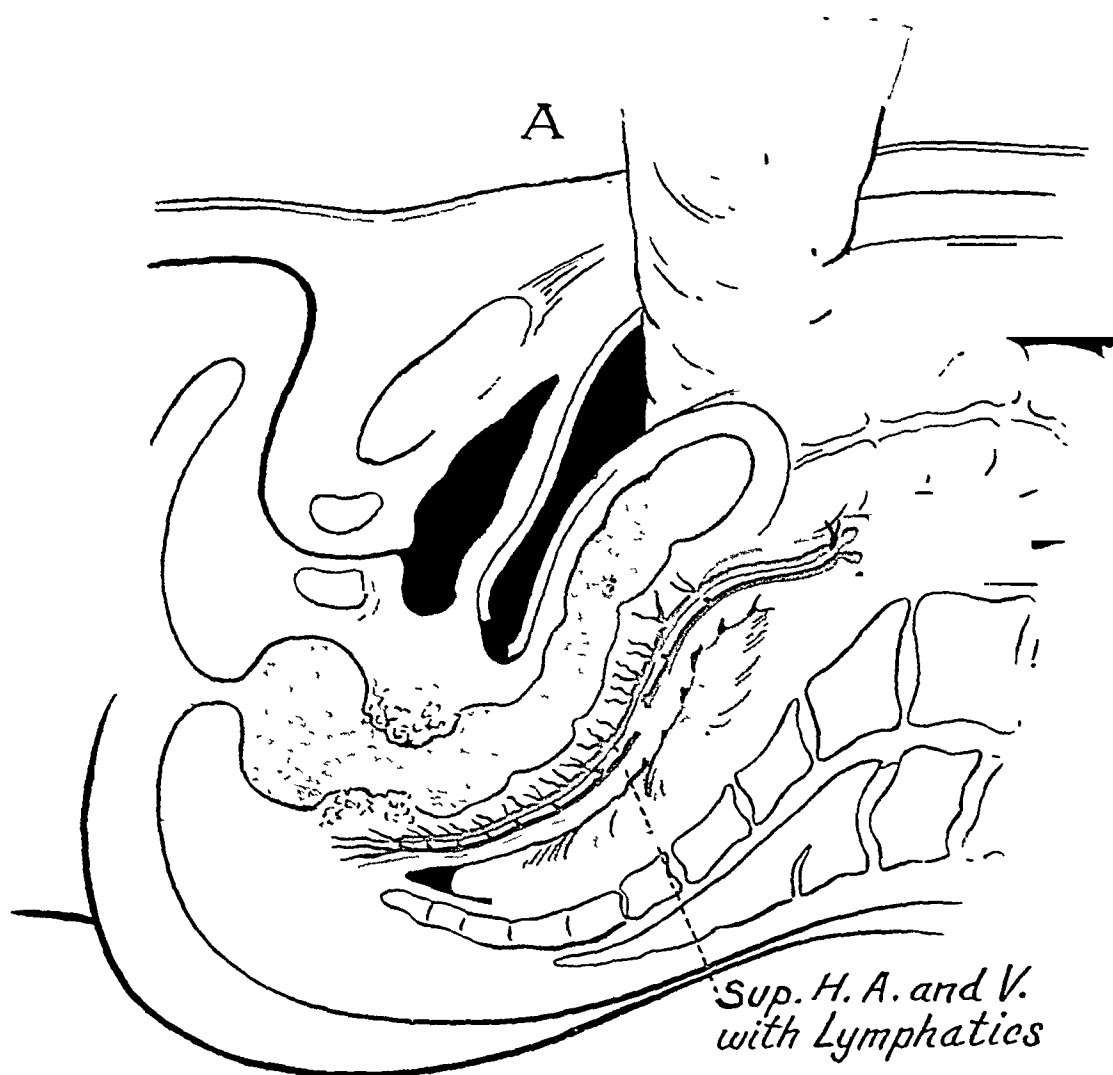


FIG. 2. A. Complete devascularization from above is possible by ligation of the superior hemorrhoidal vessels at the promontory of the sacrum. Note arteries, veins and lymphatics.

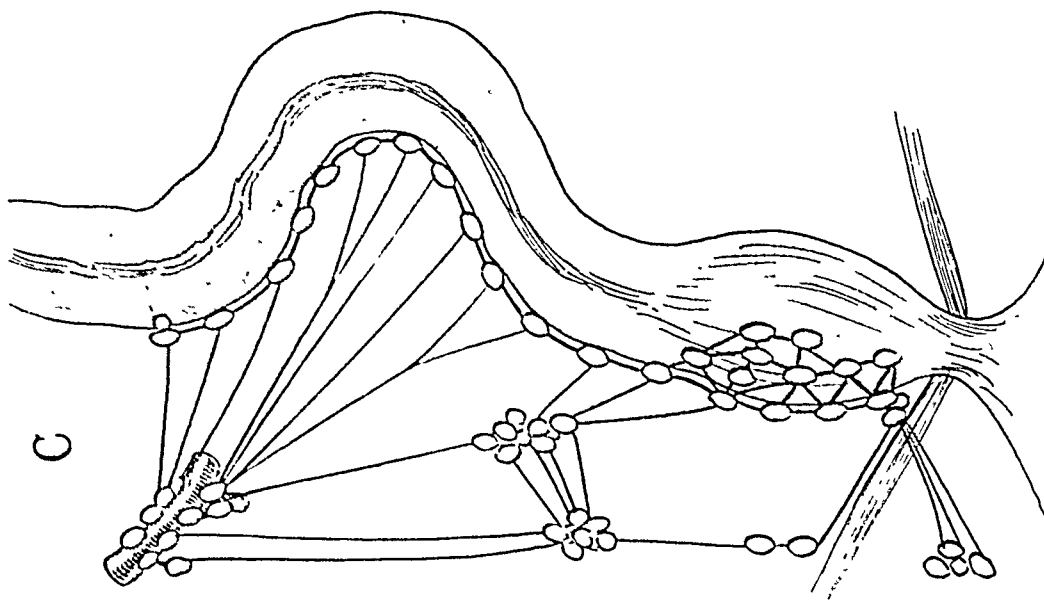
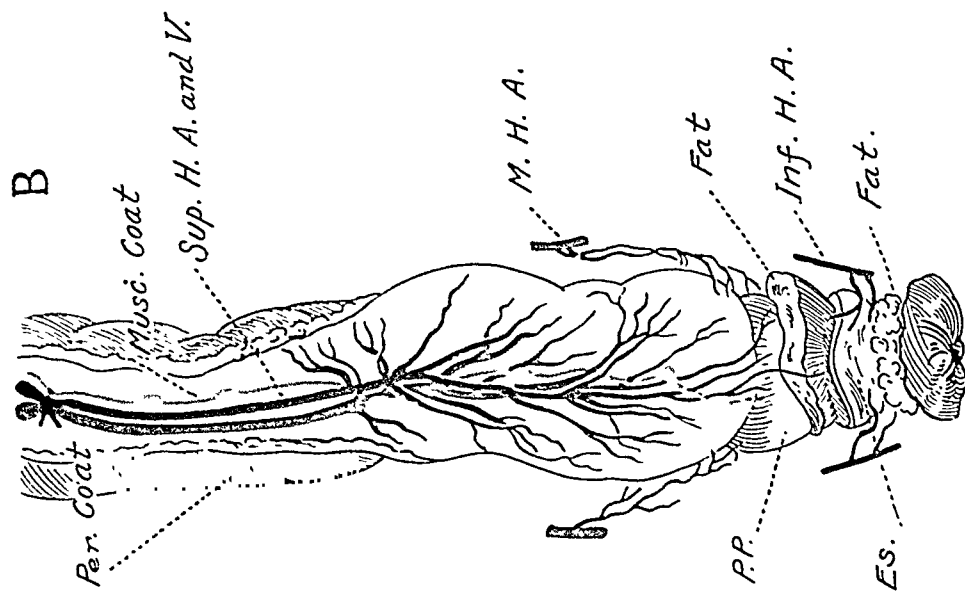


FIG. 2. B. Direct view of superior hemorrhoidal vessels and lymphatics which occupy the retrorectal space. The ligation of these vessels devascularizes the ampulla of the rectum and rectosigmoid.
c. Elaboration of Miles' picture showing the lymphatics of the rectum. (*Surg. Gynec. Obst.*, June, 1924.)

of the rectum performed at one stage rightly must be termed the "Miles operation," regardless of minor changes that may be made by someone else.

In considering two-stage operations, three definite types have been devised in this country: (1) the Mayo operation; (2) the Jones operation, and (3) the operation which is later described in this article. The Mayo operation has been termed the "posterior resection operation" which has been preceded by a simple colostomy performed a few days earlier. Theoretically, this operation falls short of complete removal of the cancer-bearing area but clinically it has produced remarkable results and is a very popular operation today, particularly in this country and in England. The Jones operation is based on the pathological principles enunciated by Miles. The principle by which the operation is performed in two stages is highly original. At the first operation, besides bringing up the bowel for a colostomy and ligation of the inferior mesenteric artery as Miles has done, he carefully preserves the colonic arches along the sigmoid by which an adequate circulation is preserved to maintain the vitality of the bowel until the second operation is performed. He then removes the fat and glands in the hollow of the sacrum, the base of the mesentery of the sigmoid, and mobilizes and elevates the pelvic parietal peritoneum and sews it across the pelvis as a new pelvic diaphragm which is brought around the intestine sufficiently high above the growth that the second operation for removal of the growth will be extraperitoneal.

Cancers located in the lower 8 inches of the bowel are usually classified as cancer of the rectum and statistics compiled on this subject usually include all cancers of this segment in the same category as regards the type of surgical treatment and as regards the surgical mortality. We are learning in recent years that the principles involved in the surgery of the upper, or rectosigmoid segment, are very different from those in the lower, or ampullar segment. In studying large statistics, such as are included in Jones' recent

article, no differentiation is made in the mortality risk of the two classes of cases. I have a feeling that if the results of operation for cancer of the rectum should be separated into two classes: the high or rectosigmoid cancer and the low or ampullar cancers of the rectum, it would be found that the mortality rate is made much higher by including the rectosigmoid cancers.

In 1915, I described a two-stage abdominoperineal operation for removal of cancer of the rectum in which the major part of the operation was done at the first stage through an abdominal incision. The pelvic colon was mobilized by cutting the peritoneum on each side of the mesentery. The superior hemorrhoidal artery opposite the promontory of the sacrum was ligated. All the fat and lymphatics in the hollow of the sacrum down to the coccyx were mobilized and removed. The sigmoid was severed. Permanent colostomy was performed with the proximal end. The distal sigmoid was inverted and drawn out through the anus. The peritoneum was sutured across the pelvis, making a diaphragm which shut the inverted bowel off from the free peritoneal cavity. In the first four cases, the internal iliac arteries were ligated also. Later experience showed that it was unnecessary to ligate the iliac vessels. On account of sloughing fat resulting from complete devascularization, it was found necessary to drain with a large protected pack of gauze wicks. In general the following plan⁹ has been used in most of the cases reported in the foregoing tables:

TECHNIQUE

A long right rectus incision is made about an inch to the right of the median line extending slightly above the umbilicus. Through this incision, a search is carefully made for metastatic growths in the liver and in the mesentery and retroperitoneal glands. The growth itself is carefully examined through the abdominal incision. If a metastatic growth is discovered in the liver or in the retroperitoneal space, it goes without saying that the plan for the radical removal of the rectum should be



FIG. 3. The sigmoid is mobilized by cutting the peritoneum on each side of its mesentery. Dotted line indicates incision of peritoneum of cul-de-sac around rectum and between bladder and rectum with long handle angle scissors.

abandoned for palliative measures; likewise, if the growth involves the bladder or the firm pelvic wall. This long incision serves the purpose for exploration and for the manipulations

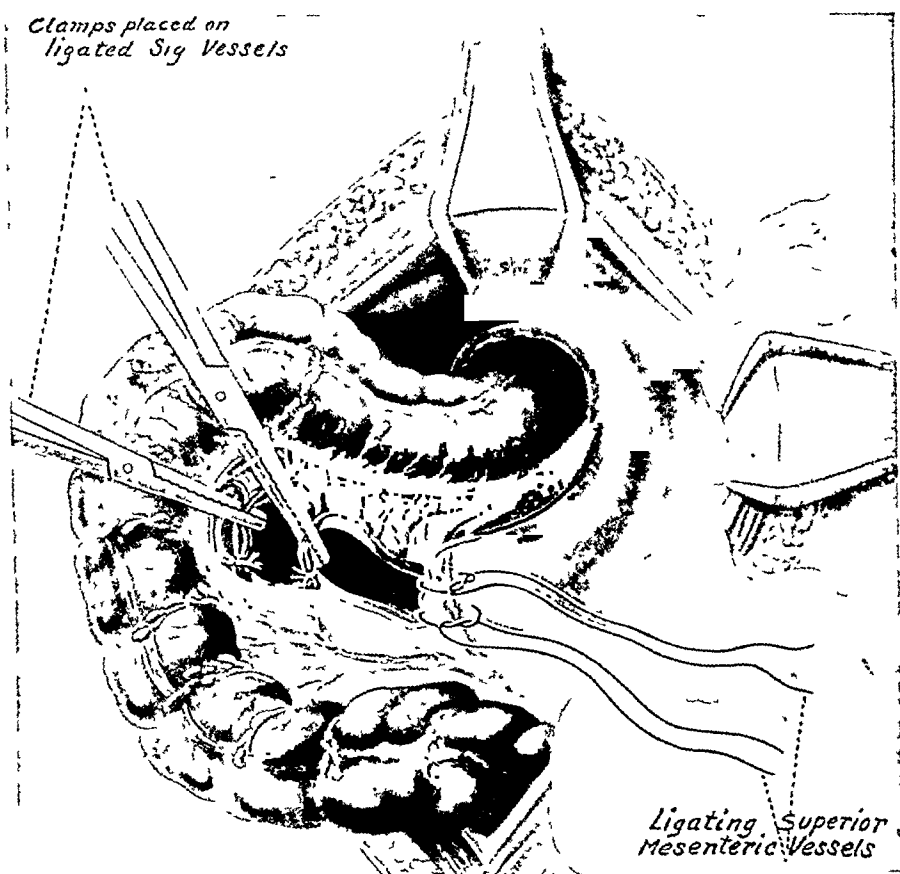


FIG. 4. Two ligatures placed around the superior hemorrhoidal vessels about 1 inch apart. The sigmoid arteries tied on one side and clamped on the other.

of the operation. It is made on the right side because the permanent colostomy is to be made on the left side. It is always best to make a colostomy wound through a separate stab wound. By having the large operating incision on the right side and the colostomy on the left side, it is possible to protect the large clean wound from the infection of the colostomy.

Having decided to do the radical operation, the intestines are packed well up into the upper abdomen with moist gauze, the exception being the sigmoid which is brought entirely below

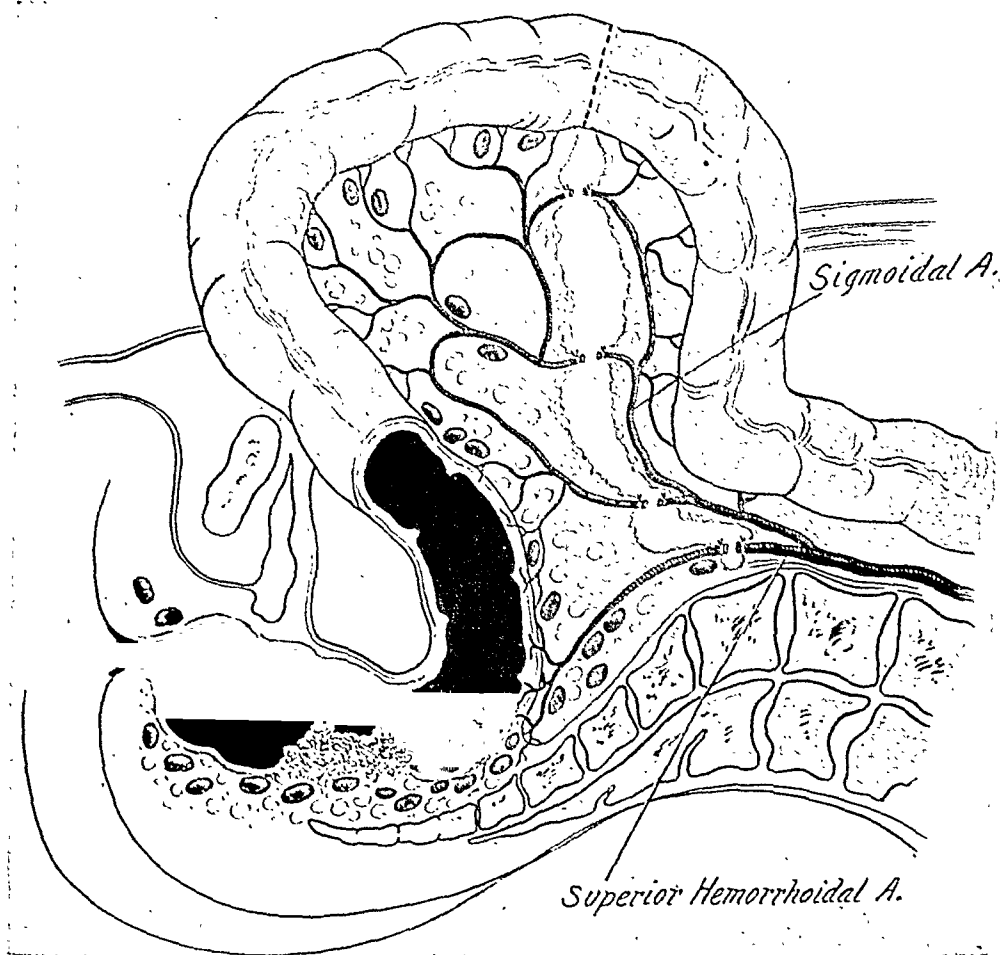


FIG. 5. Low cancer of the rectum. The dotted line across the intestine and the severed blood vessels indicate the amount of intestine, mesentery and lymphatic glands to be removed by the radical operation.

the wall of gauze. With the left hand, the loop of the sigmoid is lifted high up, the peritoneum of the mesentery is cut down by insinuating the blade of a pair of blunt scissors beneath the peritoneum but external to the vessels. This incision goes down into the pelvis around in front of the rectum, at some distance from it, clipping the rectovesical fold near the bladder. Special angle scissors are made with long handles and a

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blunt or probe point on the lower blade (Fig. 3). The left forefinger is now inserted through the mesentery where the peritoneum has been cut and with the ends of the forefinger

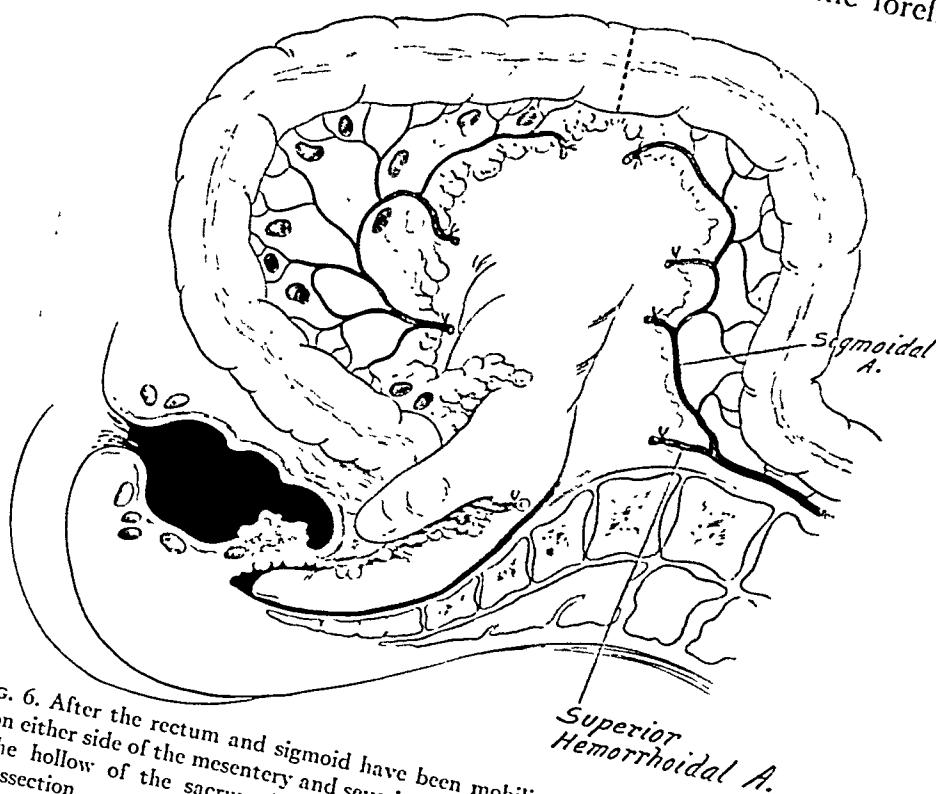


FIG. 6. After the rectum and sigmoid have been mobilized by cutting the peritoneum on either side of the mesentery and severing the rectal and sigmoid arteries, the fat in the hollow of the sacrum is mobilized down to the tip of the coccyx by finger dissection.

and thumb directed backward toward the promontory of the sacrum, and brought together, the superior hemorrhoidal artery is felt about $\frac{3}{4}$ of an inch in front of the bone. Its pulsation is about as strong as the radial artery. A large ligature, usually a double chromic catgut suture, No. 2 size, is passed beneath the artery with a long curved ligature carrier, the loop of thread is picked up on the opposite side and brought through the mesentery and around the large vessel and tied very tightly

in order to squeeze out the fat in the mesentery. A similar ligature is placed an inch lower down. The mesentery, including the artery and vein, is now severed between the two ligatures. The sigmoid arteries coming from above are grasped in forceps and ligated so as to cut off completely the circulation from this source. (Fig. 4.) The fingers of the left hand are then insinuated between the ends of the severed superior mesenteric artery and also between the lateral cut edges of the mesentery and pushed downward along the hollow of the sacrum, thus stripping off all the fat and connective tissue down to the tip of the coccyx. (Figs. 5 and 6.) If there is any return bleeding in the cut mesentery from below, this is stopped by grasping with forceps. After this separation, a large temporary gauze pack is placed in the hollow of the sacrum back of the rectum while the second major step of the operation is performed.

Before beginning this second step, we carefully determine the vitality of the circulation in the upper sigmoid which is to be used for permanent colostomy. It is very important to have a good circulation. This having been determined, an incision about $1\frac{1}{2}$ inches to the left of the median line and about 1 inch below the umbilicus, $1\frac{1}{2}$ inches in length, is made down through the left rectus muscle. A large Payr clamp is inserted through this incision, passed across within the abdomen to the main incision, where it grasps the proximal sigmoid at a point where it has been determined the circulation is good. Another clamp is placed just below, except that this clamp is in the main wound. The intestine is then severed with the cautery which is made to heat the blades of the clamp and thus sterilize it before it is drawn out through the wound (Fig. 7). It is pulled well up through the wound with the clamps where it is sutured to the layers of the abdominal wall, with fine double chromic catgut placed as a lock stitch, first sewing the peritoneum to the bowel wall, then the aponeurosis and finally a few interrupted sutures hold the skin to the peritoneal surface of the bowel. Usually about an inch of the bowel remains outside the skin.

When this part of the operation is completed, a rectal tube which was introduced into the anus by a nurse at the beginning of the operation, is now pushed up through the sig-

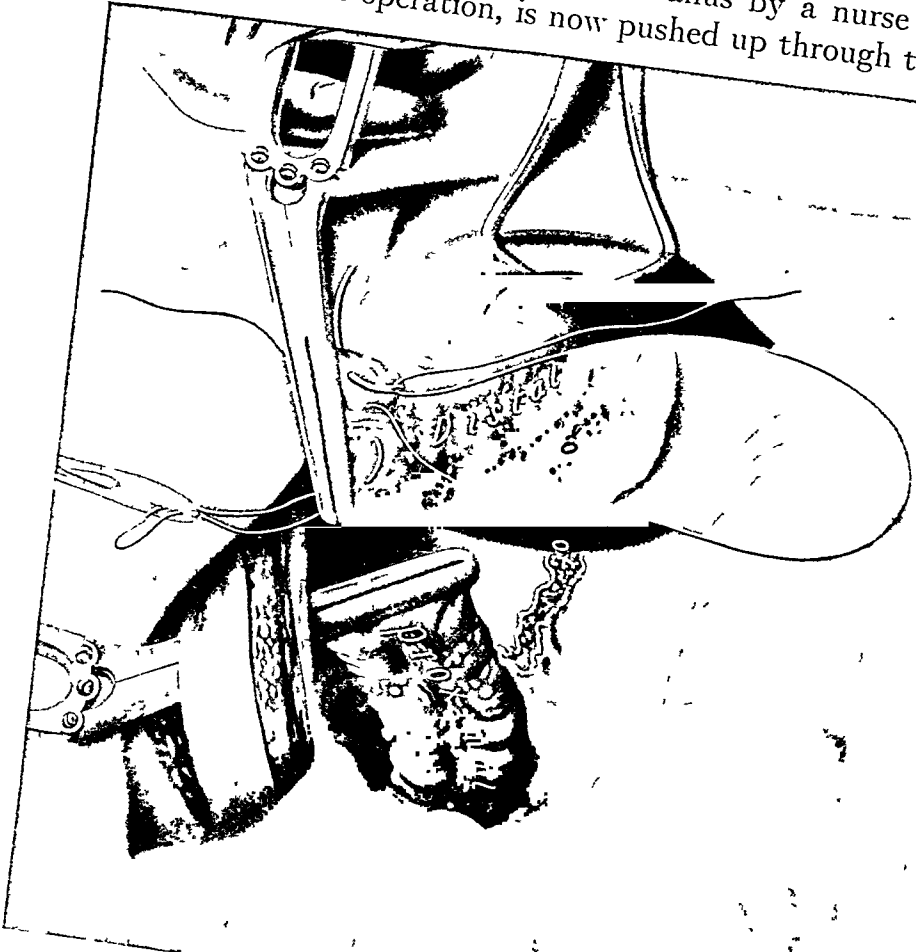


FIG. 7. Clamping and cutting the sigmoid after the vessels have been ligated. Note that one of the clamps passes through the stab wound in the rectus muscle.

moid to the point near the clamp on the distal gut. A purse string of linen is placed around the gut below the clamp, the clamp is removed, the end inverted. The tube is pushed up to the end of the gut, its eye is located, a round needle armed with four strands of strong linen thread is passed through the

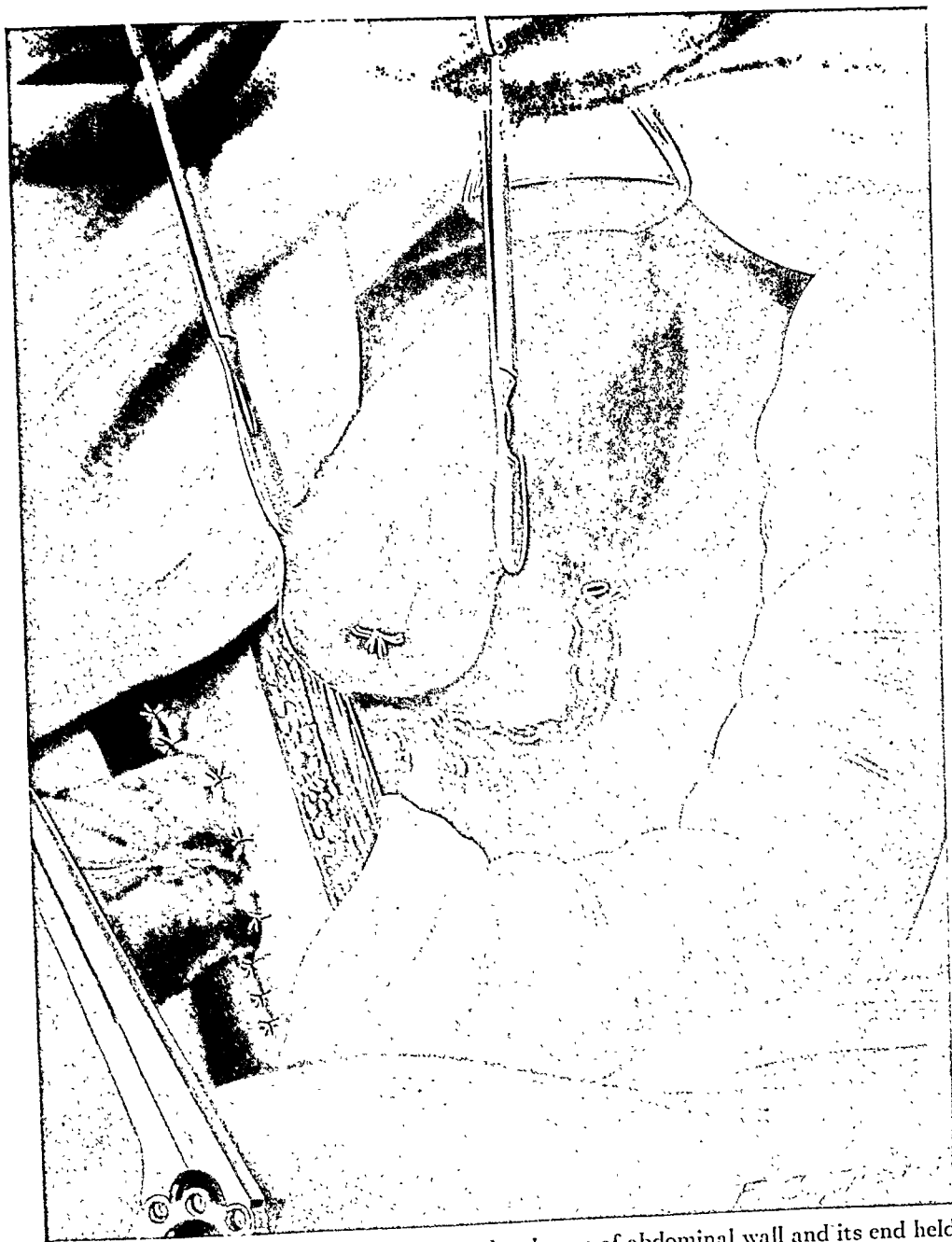


FIG. 8. Proximal sigmoid has been fastened to layers of abdominal wall and its end held closed with a clamp. Tube is passed up to end of distal sigmoid, where it is fastened by a strong double suture passed through the intestine and eyes of tube and tied. By pulling on the tube, the sigmoid is inverted and drawn out through the anus.

wall of the intestine, through the eye of the rectal tube, out through the end of the rectal tube, through the opposite wall of the intestine and is brought out and tied in a long loop fully an

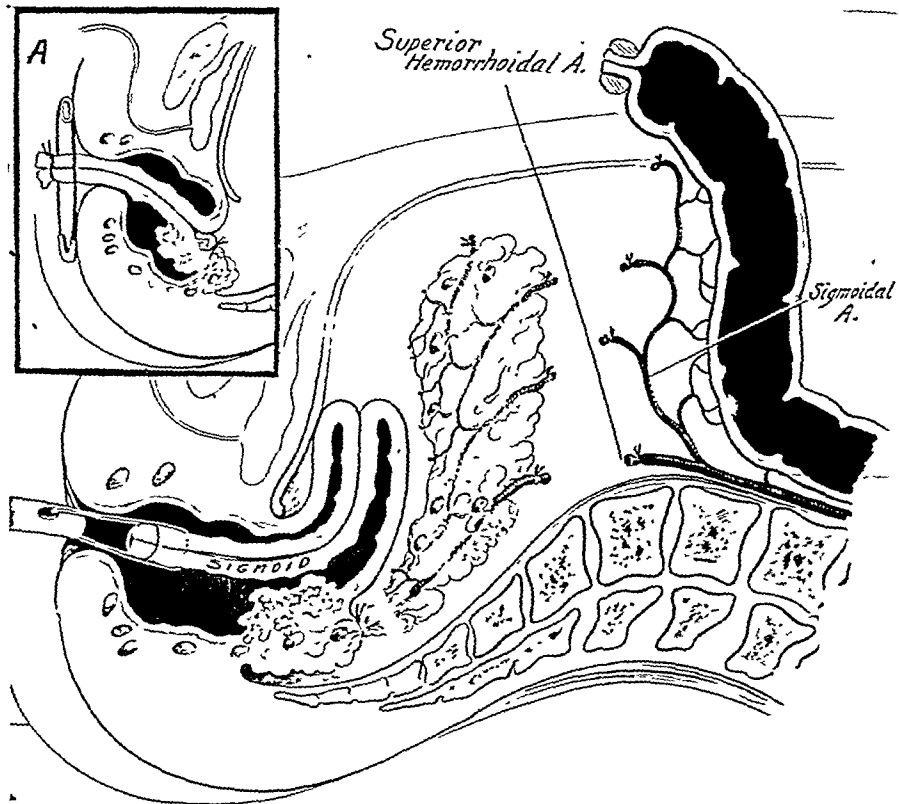


FIG. 9. Sigmoid is being inverted and drawn out through the anus. The mesentery of the sigmoid and rectum has been ligated and is being removed. The proximal sigmoid is brought out through the left rectus muscle for a colostomy. In insert A the inverted sigmoid is pinned outside the buttocks so that it cannot retract.

inch in length. The mesenteric fat on this distal gut is now trimmed off well down to the bottom of the pelvis; as much of the large sheet of fat which has been peeled off from the sacrum as possible may be ligated and removed. Artery forceps grasp the intestine on either side (Fig. 8), the nurse pulls on the tube, inverts the end of the gut down to the holding forceps when the forceps are made to grasp further down on the intestine, then the gut is pulled all the way down and out through the anus,

where it is held taut in inversion by a clamp placed on it on the outside or by a large safety pin. This loop of thread which attaches the rectal tube to the inverted end of the gut is made long so that the tube precedes the inverted end in going through the narrows of the growth. (Fig. 9.)

The next step in the technique of the first stage is to close all raw surfaces and openings so as to reduce to the minimum the danger of adhesions or postoperative obstruction. This is done as follows: First, the abdominal space to the left of the emerging sigmoid is closed by a double chromic catgut beginning in the lateral parietal peritoneum over the psoas muscle. A continuous lock stitch brings together the peritoneum of the front and back walls of this space. These sutures should be drawn very taut and should leave no open space. An extra reinforcement line of interrupted sutures is often used. From this point, the continuous suture is carried on down, covering in the raw cut edge of the mesenteric fat to the brim of the pelvis. At this point in the operation a large number of gauze wicks are carefully placed so that they reach the bottom of the pelvic cavity in contact with the hollow of the sacrum or coccyx. There should be enough of these to fill the deep pelvis loosely.

Increased experience has shown that the more gauze used in this pelvic drain, the better the patients have done until now three times as many gauze wicks are used to pack the hollow of the sacrum as was originally recommended. The reason for gauze drainage here in preference to a tube or other smooth material is that the retroperitoneal space to be drained is connective tissue space arranged in cells or spaces like a sponge. Fluid and any infection that it may contain are held by capillary attraction. A tube or soft substance will not drain connective tissue space. A large amount of gauze packed into connective tissue immediately drains out all fluid by capillary action until nature has a chance to form a definite wall of granulations. Those who have done this operation and have failed to use the gauze drainage have not met with success. Sheets

of 4-ply gutta-percha tissue are now made to surround the gauze wicks.

The suture is now continued, its scope being widened so as

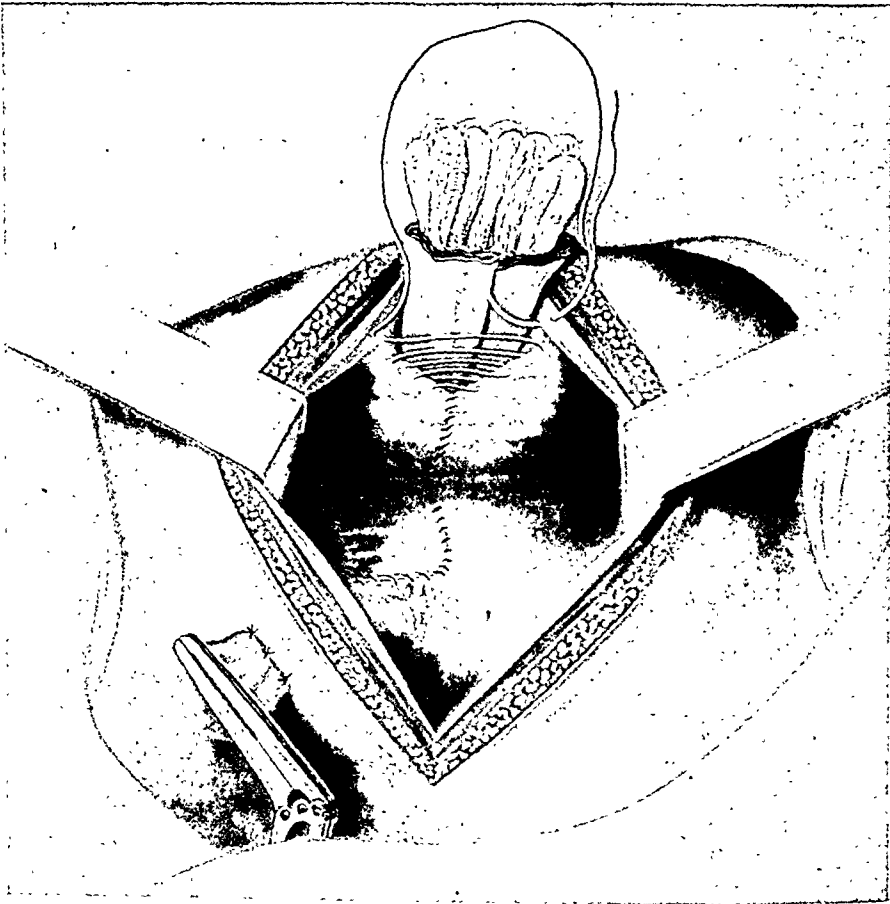


FIG. 10. After the space between the sigmoid and the left parietal peritoneum has been closed by suture, a continuous catgut is run along the mesosigmoid covering the raw fat edges with peritoneum down to the upper portion of the cul-de-sac, where drain is inserted. The suture line continues to bring the parietal peritoneum from the sides of the narrow pelvis around the drain until the abdominal incision is reached, making the drain extraperitoneal.

to bring in the peritoneum of the lateral walls of the pelvis snugly around the drain. This suture continues forward until the peritoneum is closed around the drain up to the lower end

of the long abdominal incision (Fig. 10). Thus the drain becomes extraperitoneal.

At times a large portion of the peritoneum has to be removed and it is impossible to close the space with healthy peritoneum. In the presence of a large omentum, it is possible to suture the omentum to the posterior parietal peritoneum around the brim of the true pelvis at the lumbosacral prominence and to the mesocolon in such a way as to shut the intestines entirely above this omental diaphragm. Then it is perfectly safe and simple to put a large quarantine into the lower space without surrounding it with a tube of peritoneum. The intestines push the omentum down and it fits itself around the quarantine drain. At other times where much of the peritoneum has been removed on account of malignancy, a simple large pack of gauze has been placed surrounded with rubber tissue above until nature has formed her own wall. Miles has called particular attention to the type of case in which a large amount of peritoneum has been involved and therefore must be removed.

Thus all the raw surfaces and openings which would favor postoperative adhesions or postoperative obstruction have been closed, the devitalized tissue has been pushed down to the field of the second operation, and separated by an extraperitoneal quarantine which also takes the place of a drain (Fig. 11). The question of passing a drain up through the rectum through a puncture in the vault of the rectum above the growth into the cavity containing the devitalized tissues, or inserting a drainage tube through the space between the rectum and the sacrum for the purpose of draining the devitalized area, was the first consideration, but experience caused me to decide in favor of the method described for the reason already expressed: that a tube does not properly drain fresh connective tissues while gauze, being capillary, drains upward even better than downward.

The original operation in woman differed from the standard operation just described in two points:

1. When the time came to place the quarantine, a long forceps was passed into the vagina, a hole was made in the posterior fornix through the septum into the cul-de-sac. Enough

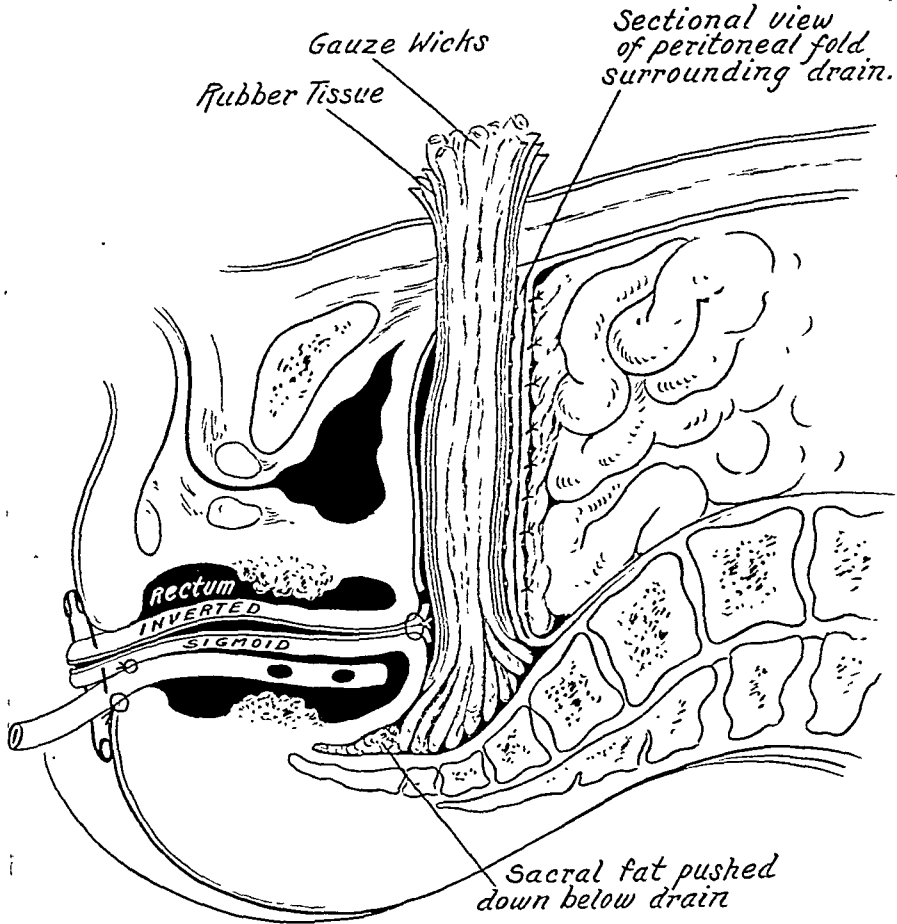


FIG. 11. Sectional view of drains which have been enclosed in a tube of peritoneum drawn in from the pelvic wall. Fat in hollow of sacrum is pushed down, a drainage tube in rectum and inverted sigmoid held down by a safety pin. Omentum has been sewed to the line of peritoneal sutures to add extra strength.

wicks to make a roll of gauze an inch or more in diameter were put in the grasp of the forceps and drawn out through the vagina, leaving enough of the wicks inside the cul-de-sac to turn over the end of the inverted rectum into the hollow of the

sacrum and coccyx where it was to form a quarantine, and was also to serve the purpose of a drain.

2. The uterus may be turned backward into the hollow of the sacrum and sewed around to the parietal peritoneum for the purpose of making a good abdominal floor and an intact peritoneal cavity or it is very easy to use the pelvic peritoneum back of the uterus.

Experience proved that when this technique of drainage was used in women, the sepsis was always greater than was noted in men where a large amount of gauze drainage was brought out through the lower wound, so we have practically abandoned vaginal drainage and have adopted the massive protected gauze wick pack coming out through the lower angle of the abdominal incision in women as well as men.

Having completed the vital parts of the operation, the large abdominal incision is closed, the Payr clamp on the protruding end of the sigmoid is removed and a Kocher forceps applied in its place to hold the intestine closed until it is desired to open it. The forceps is fastened to the abdomen by adhesive tape.

For the protection of the main wound from the contents of a colostomy when the gut is opened, I have for a long time used a collodion dressing which is put on as follows: The skin between the wound is thoroughly dried with pure alcohol followed by dry gauze. A layer of gauze, one thickness, about 8 inches by 4 inches, is laid over the main wound with its edge on the skin between this wound and the colostomy wound. This edge is fastened to the skin for about an inch with collodion. A sheet of rubber tissue about the same size is laid over the gauze but not quite reaching the edge. Then another layer of gauze, the size of the first, is laid on top of the rubber tissue and its edge fastened to the edge of the first layer of gauze and the rubber tissue by more collodion. Another layer of rubber tissue is laid on top of this collodion to prevent its sticking to the gauze dressings. A roll of gauze is then laid on top of this between the covered wound and the colostomy (Fig. 12). This dressing

thoroughly protects the clean wound from the colostomy so that the wound should heal without breaking down.

The requirements of the principles laid down for the

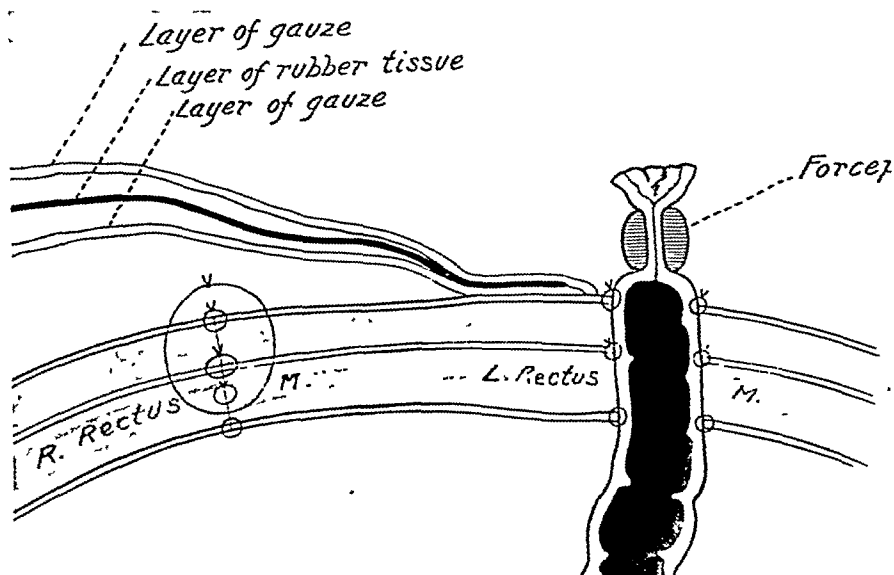


FIG. 12. Cross section of abdominal wall showing the collodion dressing and its relation to the wound and to the colostomy.

first stage of the operation having been met, the operation is halted until a complete anatomical and physiological abdominal mechanism has been re-established. By this we mean that the sutured peritoneum above the quarantine has firmly healed, the abdominal wound has healed, the artificial anus is firmly established and acting well, the patient's pulse and temperature are practically normal and the patient's digestive apparatus is functioning normally. This is usually accomplished about the tenth day after this first operation. Occasionally, we do the operation a little earlier but sometimes the second operation is delayed several days longer until the patient is in a good healthy condition. In the meantime, the cancer has been largely cut off from its support, is quarantined from the rest of the body to a great extent, and is almost harmless for the time being. The most startling and

spectacular thing that takes place during this interval between operations, is the line of cleavage between the tissues which have been devitalized and are to be removed and the normal structures which are to remain. This change makes the second operation a minor affair. In very feeble patients, we have recently used a three stage operation, the first of which is a simple colostomy. After the colostomy, the patient is allowed to be up and about for sometime before the main operation is done.

When we are ready for the last operation, we still have in place the quarantine which is allowed to remain as a landmark in doing the second operation.

The patient, if a man, is placed on an operating table which breaks in the middle. He lies on his face with both head and feet lowered in the jack-knife position. Incision is made from the center of the lower part of the sacrum down to within an inch of the anus, where it divides and surrounds the anus and all the anal muscles; any bleeding vessels may be caught with forceps; the coccyx and lower end of the sacrum are exposed; the last joint of the sacrum with coccyx is removed with bone forceps; the fingers of one hand are insinuated between the sacrum and the ischiorectal fat until the cavity containing the quarantine is reached (Fig. 13). Usually there is a good deal of pus and debris in this cavity, which is entirely ignored as harmless. The fingers are then pushed over farther around the end of the inverted rectum and above the growth and the rectum, and all are peeled out *with an ease and completeness which is not believable until one has actually had the experience*. In the process the levator ani muscles are exposed and removed. The usual time required for this last operation from the time of the first incision in the skin until the specimen is entirely removed is about five minutes without any necessity for hurrying.

Except around the anus and anal muscles, the bleeding is not sufficient to require the use of artery forceps. At no time is there danger of serious loss of blood. Nature for some reason

has, during the interval following the first operation, formed a line of cleavage which is very definite. The fingers follow this line of cleavage without particular care. After the rectum is out the seminal vesicles, prostate gland and bladder are in plain view. The clean cavity left after removal of the rectum in this way is very surprising. The large wound is now packed with gauze to absorb the fluids and control oozing. If the patient is anemic or in the least shocked, blood transfusion should be used freely.

In woman, for the last operation, the Murphy method is used. The vaginal mucous membrane and perineum are incised down to the rectal wall. If the growth is located on the posterior wall of the rectum, the mucous membrane of the vagina is simply lifted and allowed to remain. If the growth is in the front wall of the rectum, the posterior wall of the vagina is removed with the rectum. After this incision in the vaginal wall is made, the fingers of the left hand are passed through into the drainage cavity, made to curve around the inverted rectum, follow down past the coccyx and peel out the growth with the rectum and the muscles around the anus, which are cut as far distal to the growth as possible. The perineum may be partially sutured.

This inversion operation is not applicable to cancer of the rectosigmoid, and is not applicable in those cases of cancer of the rectum in which the growth has progressed to the stage of actual obstruction, for the reason that the sigmoid cannot be inverted through the growth. This type of operation not only has made cancer of the rectum one of the most hopeful cancers of the body but has reduced the mortality to a very low rate as shown by the foregoing statistics.

The first attempt to apply the principles of this type of two stage operation to the rectosigmoid cancer was in 1922.⁹ It differed from the operation for cancer of the rectum proper in that the sigmoid could not be inverted through the anus. Therefore, the growth was removed at the first operation.

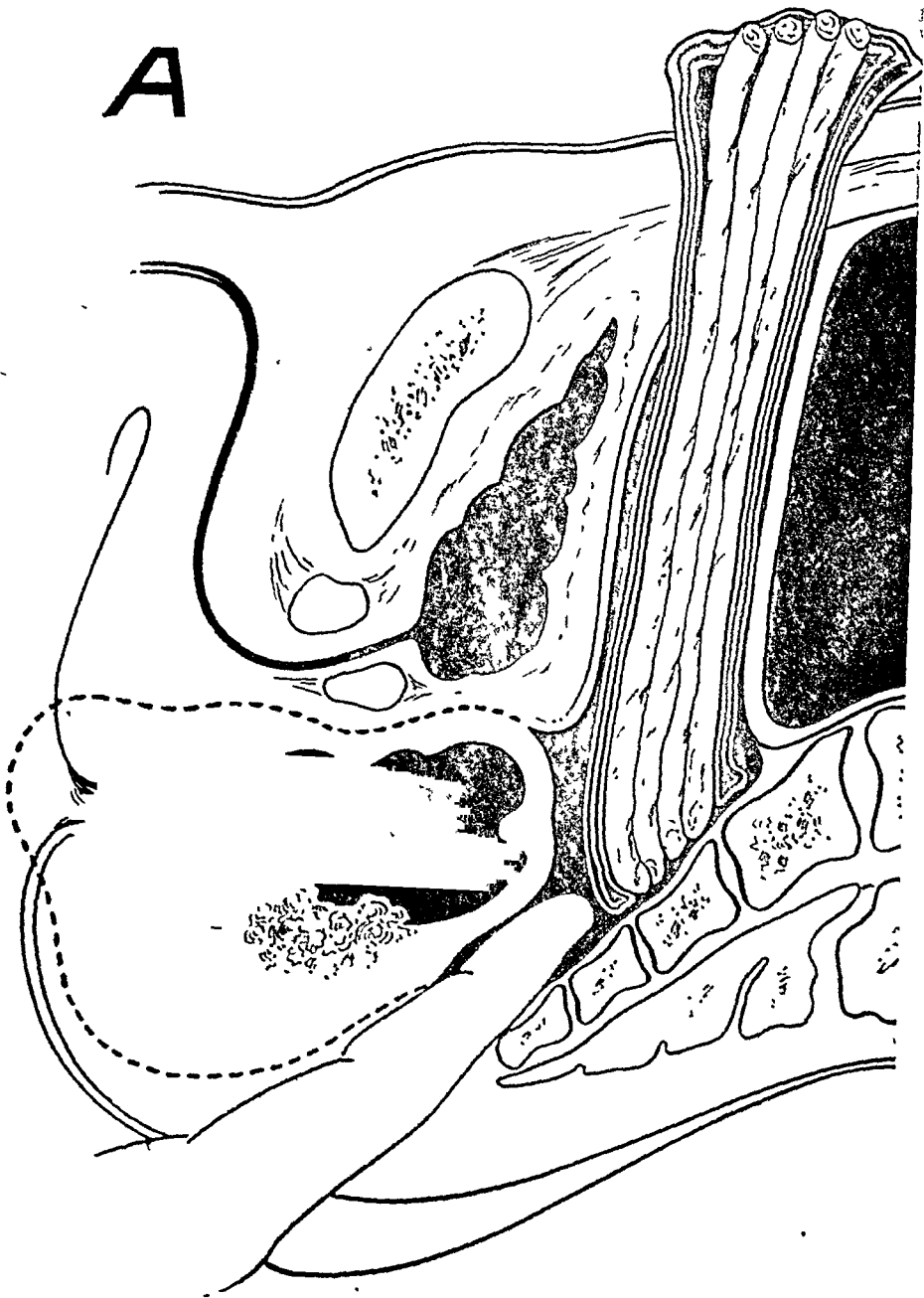


FIG. 13A.

FIG. 13. Second step of the operation. The coccyx and last joint of the sacrum are removed and after an incision is made around the anus to include the anal muscles, the fingers easily enucleate the rectum without hemorrhage (A and B), leaving a large open cavity to heal by granulation (c).

B

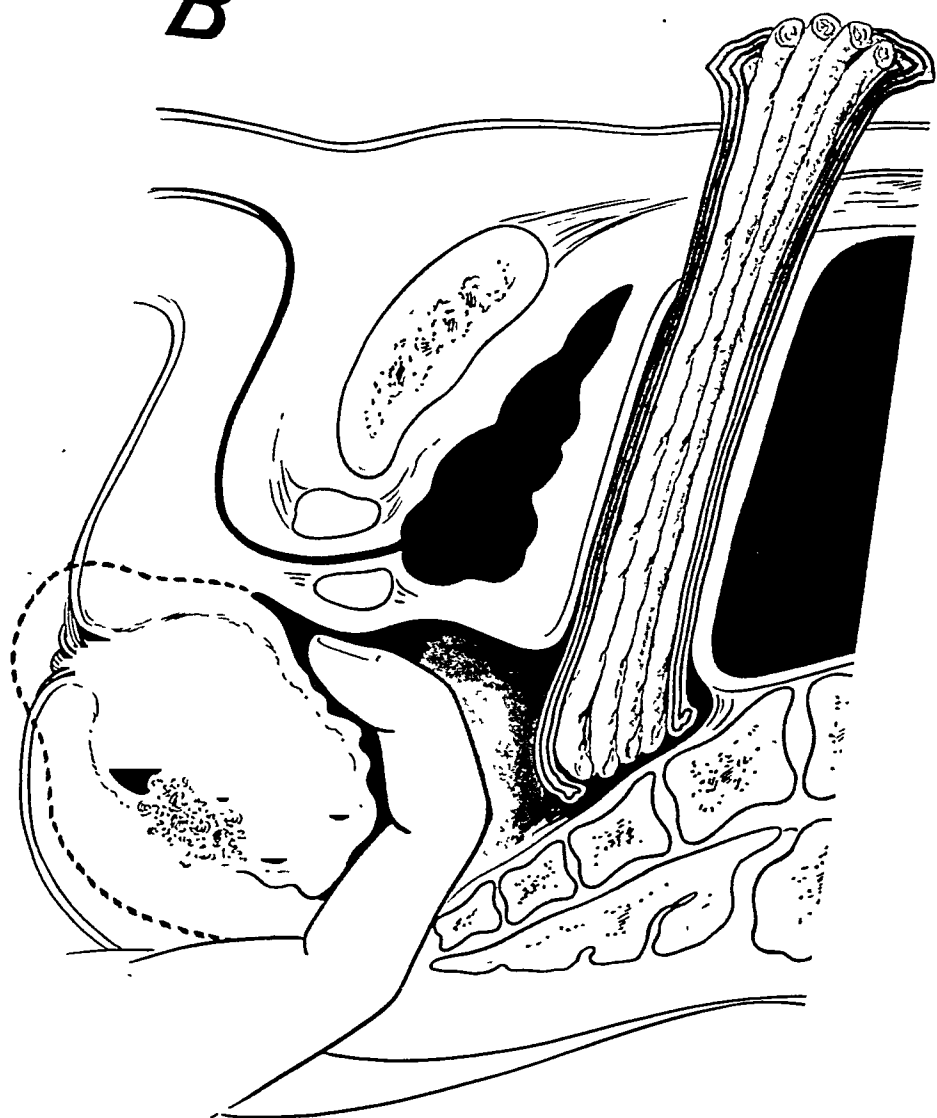


FIG. 13B.



FIG. 13c

This operation for rectosigmoid cancer performed in two stages presented no greater difficulty of manipulation and required no more technical skill than the operation for cancer

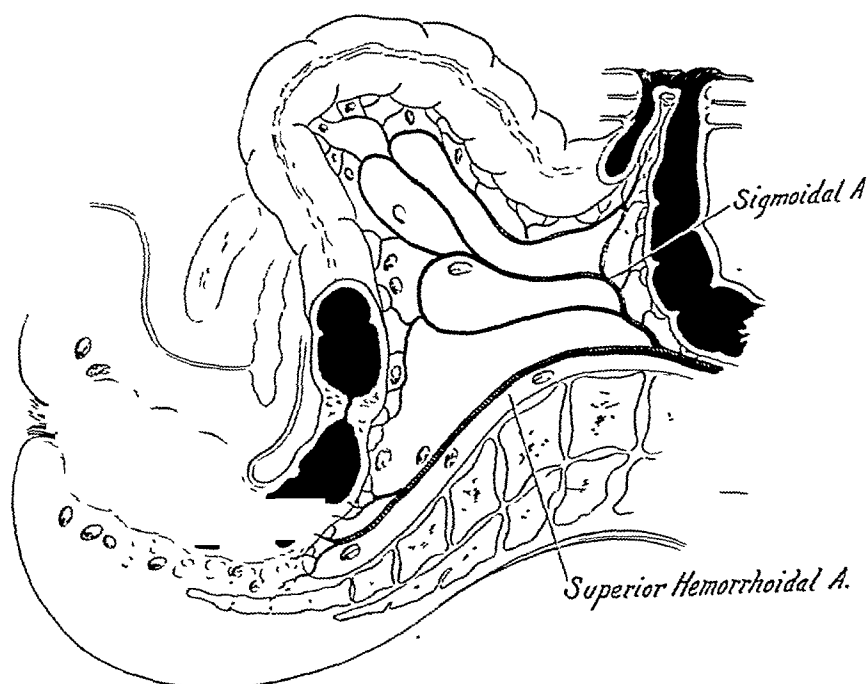


FIG. 14. Preliminary colostomy for cancer of the rectosigmoid which is left open from two to four weeks before the two-stage operation for removal of cancer of the rectum is begun.

in the ampulla and yet the mortality was more than twice as great. Gradually, it was observed that in cases where an emergency colostomy for rectosigmoid obstruction had been done by the family doctor some weeks or months previously (Fig. 14), the mortality was no greater than followed operation for cancer of the rectum. In these cases with previously established colostomy, the remaining operation was divided into two further stages as follows: the sigmoid was severed below the colostomy, the proximal end turned in, and the distal sigmoid including the growth and all the mesentery of the sigmoid and fat in the hollow of the sacrum were removed (Fig. 15).

The distal stub of the rectum was either turned in or held in a clamp, the quarantine placed in just the same way as if the rectum had been inverted and drawn out through the anus

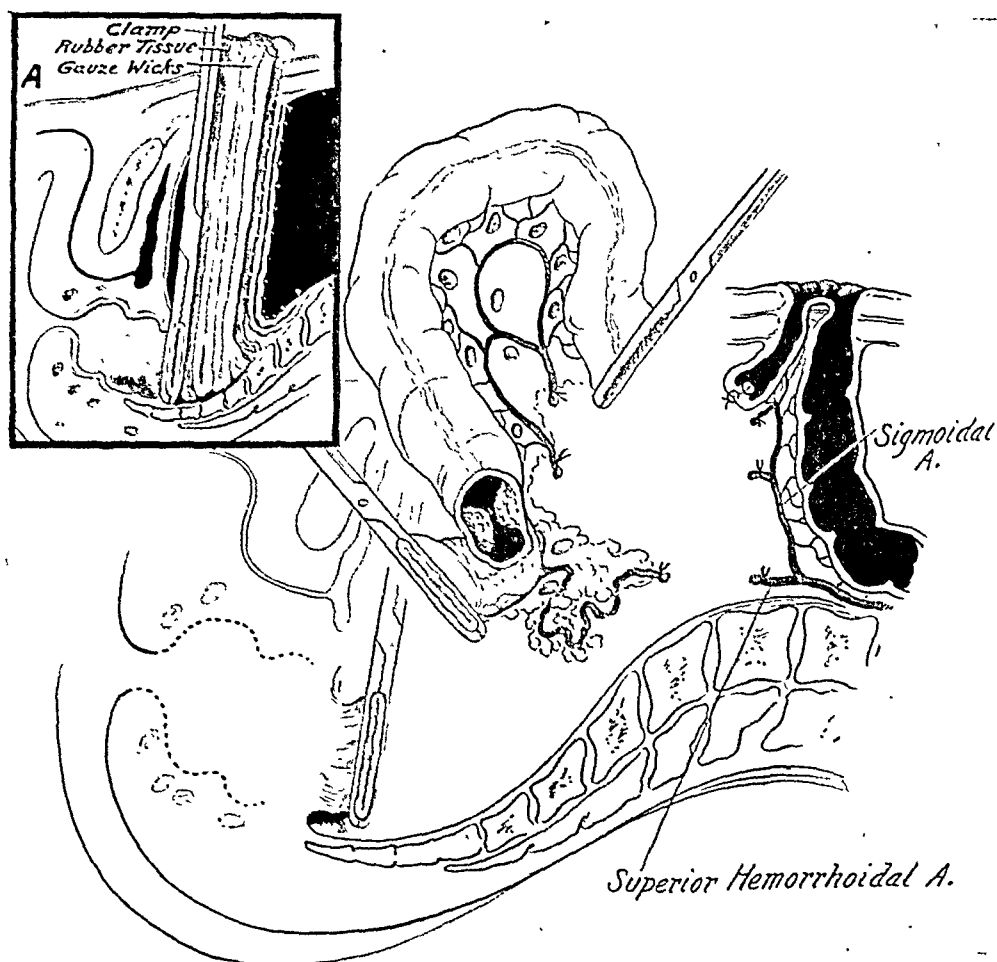


FIG. 15. Two to four weeks after the colostomy has been performed, the abdomen is opened through the right rectus, the vessels are ligated, the intestine severed and mobilized as in Figures 6 and 9, after which the sigmoid is clamped and severed between clamps below the colostomy and below the growth. The distal stub of rectum held in a clamp or inverted with a purse string, and the area drained with a quarantine pack (Insert A). The rectum is later removed as shown in Figure 13 A, B, and C.

(Fig. 15, insert A). From one to two weeks later, the remaining rectum was removed. This points to the fact that there is something to be considered in connection with cancer of the rectosigmoid that did not exist in cancer of the rectum.

Study of the preoperative histories of cases of cancer of the rectosigmoid shows that the first symptoms noticed by the patient is usually a diarrhea, which may or may not have been preceded by a noticeable constipation. This diarrhea is usually accompanied by a small amount of blood mixed with pus. The diarrhea is due to bacterial action above an intestinal obstruction. The rectosigmoid in the first place is a rather narrow segment of the bowel, furthermore it is surrounded partially by peritoneum. The growth here instead of beginning with an ulcer on one wall of the bowel and gradually extending by radial growth around it, seems to proceed to the formation of a thin, narrow annular obstructive stricture.

A gradually narrowing growth of the sigmoid or lower bowel which produces a slow obstruction, causes a reverse peristalsis and constantly throws back the fecal matter into the cecum. The cecum becomes dilated in nearly all cases and in some cases becomes enormously dilated and in a few instances reported in the literature it has been distended by obstruction in the sigmoid to a point of actually producing gangrene. A severe intestinal toxemia accompanies such a condition. This has been very forcibly brought home to me in the case of one of my very good friends. He had been my patient for several years and had been operated upon for obstruction of the common duct. One day he came in and said that he wanted to take a trip abroad and would like to have me examine him. I said, "How have you been?" His reply was, "I have been splendid but during the last three weeks I have noticed a diarrhea and I would like to see what can be done about it." A patient past sixty years of age who has been in good health and never subject to bowel disturbances who suddenly begins to have diarrhea which is persistent and with which is a certain amount of gas pain in the abdomen, becomes the subject of grave concern. In a very large percentage of cases the diarrhea is produced by an obstruction in the pelvic colon and this obstruction at this age is nearly always cancer. He was placed on the examination table and there was felt

an obstructing carcinoma at the rectosigmoid junction. I urged him to lose no time in coming to the hospital. An attempt to clear his bowel with cathartics was only par-

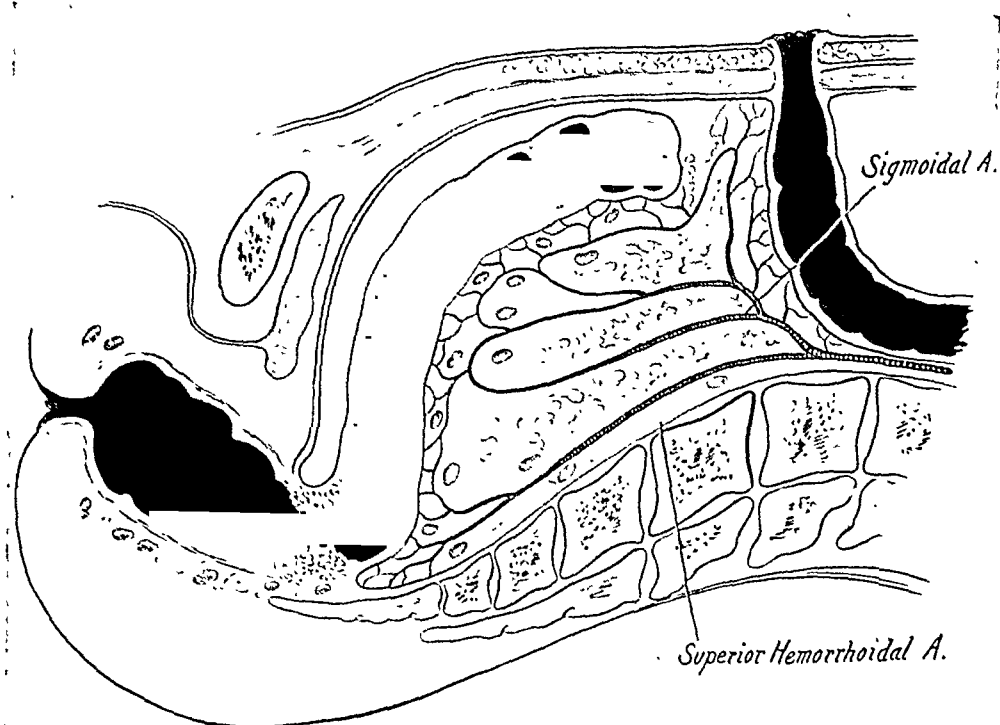


FIG. 16. If the obstruction is not complete, it is sometimes well to sever the sigmoid and drop the inverted distal segment back into the peritoneal cavity as a part of the colostomy operation.

tially successful. At the chosen time, an incision was made in the left rectus muscle for the purpose of doing a colostomy. A loop of bowel was brought up through the incision for a colostomy. Two days later, the bowel was opened with the cautery. Relatively a small amount of gas and fecal matter escaped and some relief was obtained, but the abdomen still remained distended and the patient developed hiccough and a certain amount of vomiting. The abdomen was then opened high up with a median line incision in the expectation that we would probably find a loop of small bowel which was obstructed. Instead we found an enormously distended cecum with a certain amount of distention of the transverse

colon. The cecum was so located that it would not be brought into the wound without making another incision. Therefore, the transverse colon was brought into the wound and fastened where it was left for a few hours and then opened and a tube was passed upward and a considerable amount of gas and fecal matter escaped through the tube, but it did not completely drain the cecum, and the patient died on the fourteenth postoperative day.

Since that time, I have done no operation for cancer of the rectosigmoid until a functioning colostomy has been thoroughly established and the patient has been restored to entirely normal gastrointestinal habits. Usually the patient is allowed to get up for a few days or weeks before the radical operation is performed. Another precaution which I have always taken since that time is to examine the cecum carefully. If the cecum is distended, it is brought through the right abdominal wall for a possible cecostomy. If no trouble develops and the colostomy on the left side functions perfectly after being opened, the abdominal wall is allowed to heal over the segment of cecum without opening it. If the colostomy does not empty the bowel properly, the cecum is also opened. In short, an attempt is made to bring these patients to the stage of the patient who has had his colostomy done elsewhere and has come for the radical operation. It is hard to bring ourselves to a full realization of the importance of allowing sufficient time to elapse between the colostomy and the first radical operation. As a matter of fact, the patient should be allowed to be up and around until he has established a perfectly normal gastrointestinal function and has attained his normal state of health. This method of dealing with these cases not only relieves the patient of toxemia resulting from a chronic intestinal obstruction but also establishes a functioning abdominal mechanism which does not need to be disturbed as a result of the major operation. This I think is one of the most fundamental principles connected with gastrointestinal surgery. I have heard a number of important surgeons of wide experience make the

remark that they had never known a death from pylorotomy after a preliminary gastroenterostomy had been thoroughly established. So far, in my own experience I have never known a death under similar circumstances. Similarly, I have so far not had a death in removing a cancer of the rectosigmoid where a functioning gastrointestinal mechanism had been established through a colostomy wound, and the patient had been allowed to get up and around before the second operation was done.

The principle set forth in this discussion accounts for the mortality which so unexpectedly and frequently happens after we have done a perfectly ideal resection of a simple annular carcinoma of the sigmoid colon followed by a perfect anastomosis. In other words, in discussing the subject of our paper, one is brought to realize that cancer of the rectosigmoid must be dealt with according to the principles of surgery of the large intestine higher up instead of the principles governing the operation for cancer of the rectum.

It is a growing belief among experienced surgeons that a one stage operation for cancer of the colon is rarely, if ever, justified for the reason that we here are dealing with toxemia of intestinal obstruction in addition to the growth itself. This obstruction must be treated before a serious operation can be contemplated. No more striking illustration of this has been published than the recent statistics of Professor George Grey Turner.¹⁰ He reports his entire experience with cancer of the colon with radical surgery. He makes a mortality report on 142 cases as follows:

Seventy of the cases were operated on in one stage with 18 deaths (25.71 per cent); whilst 72 were done in two or more stages with 9 deaths (12.5 per cent). In 62 cases there was a preliminary caecostomy or colotomy, and in 10 there were preliminary anastomoses. The mortality of the one-stage operations is the more to be regretted because they probably include most of the cases where the local conditions were the more favorable for removal.

The most important point in this masterly paper is that in cancer of the colon we are usually dealing with intestinal

obstruction and that the toxemia of intestinal obstruction more than doubles the risk of the operation, and must be dealt with before any thought of removal operation is contemplated. It would seem that there is no surgeon who can reliably determine those cases of obstructive cancer of the colon which he may safely do at one stage. Every surgeon of large experience has had his share of tragedies if he has attempted to do ideal resection in all cases where the simple mechanics of the situation seem to justify it. In view of the fact that no man can determine the cases he may safely resect, the only safe method is to make all operations for cancer of the colon, with rare exception, two stages or more. May it not almost be said that to do a radical resection for an obstructing cancer of the colon, which includes cancer of the rectosigmoid, without preliminary establishment of a functional intestinal mechanism and complete relief of toxemia is little short of malpractice.

CONCLUSIONS

Cancer of the rectum and rectosigmoid constitutes approximately twelve per cent of all the cancers that afflict the human body. Cancer of the rectum and rectosigmoid, because of its anatomical location, and the accessibility of its lymphatics, is one of the most curable of cancers. The operability as cases come to the intestinal surgeon is approximately fifty per cent. Of the operable fifty per cent, approximately fifty per cent are susceptible of five year cures. There may be a few surgeons of such phenomenal skill in this special branch as to enable them to do the one stage operation with a passable mortality but they are so few as to be exceptional. In view of the fact that this is a final life and death contest and that we are therefore not particularly concerned with time or convenience I am unequivocally committed to the multiple stage operation as a routine procedure, with only rare exceptions. Because of the almost uniformly good results in cases coming for operation after a preliminary colostomy has been performed elsewhere as

an emergency operation, as well as in my own practice, and because such amazing results have been reported by Professor Grey Turner and others as to the difference between the multiple stage operation and the one stage resection operation for cancer of the colon, I have become firmly convinced that the two stage radical operation should be preceded some weeks before by a simple colostomy in all cases of rectosigmoid cancer; also in all cases of cancer of the rectum in the aged and handicapped patient. If it is good for the handicapped patient, why is it not also good for the good-risk patient? Based upon these conclusions, the following plan of operation for cancer of the rectum and rectosigmoid seems feasible, and has of late been adopted in our Clinic for most cases:

A long left rectus incision is made about the middle of the rectus muscle, the lower end of the incision extending about two inches below the umbilicus. Through this incision, careful examination of the liver and other parts of the abdomen is made for metastatic growths. The pelvis is carefully examined to determine the extent of the growth. If the patient has had diarrhoea for some weeks as a result of actual obstruction and if a distended cecum is present, the cecum is brought into the abdominal wall and fixed in a convenient place for a cecostomy in case it is needed. Hendon's¹¹ enterostomy technique is probably the simplest.

The uppermost movable portion of the sigmoid is brought through the lower end of the incision which is located conveniently for the wearing of a colostomy bag. (Occasionally, the mesentery of the sigmoid is fat and short so that it is very difficult to get the sigmoid into the wound. In such a case it is sometimes advisable to use the transverse colon.) The wound is then closed above leaving a loop protruding through the lower end of the incision. If the fecal contents pass through the loop and bowels act without too much distress, the colostomy is not opened for a week or ten days in order that the wound may be healed without infection from intestinal contents. Before it is opened, the wound above is covered

with a collodion dressing or rubber tissue fastened over the wound and with rubber cement. The patient is then permitted to get up and around for a few days until bowel action has become normal and patient is in a good state of health as manifested by increase in weight. When the patient's condition is good, the major stage of one of the operations described in the preceding pages, is performed, the type depending on whether or not the cancer is at the recto-sigmoid junction or in the ampulla of the rectum. The rectum and anal muscles are removed a week or ten days later as the last stage.

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INTESTINAL OBSTRUCTION

FROM CONGENITAL DEFORMITY OF THE SMALL INTESTINE*

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BARCELONA

THIS clinical case we believe deserves to be published because of its rarity, since we have not found any similar case in the literature, and it is the more notable since in the act of surgical intervention we found ourselves confronted by a very grave problem of whether it was preferable to close the abdomen and condemn the patient to die of intestinal obstruction or better to extirpate all of the small intestine, thus exposing ourselves to the serious consequences of the lack of this intestine which plays such an important part in the physiology of digestion. Between immediate death from intestinal obstruction and the probable but more remote death of our patient, we elected the extirpation of the whole small intestine, depending on physiological aid from the large intestine. I do not know what procedure another surgeon would have followed. I thought that choosing the only route that nourished a real hope would work well.

CLINICAL CASE

M. P. C. Entered Santa Cruz Hospital on November 10, 1921 in my surgical service, occupying bed No. 28 in the St. Joseph Ward. She was thirteen years of age, a native of Sans and the neighborhood of Badalona.

Parents dead. One sister healthy.

Past history: Measles, typhoid and smallpox. She had her first menstruation three months before, four days' duration, twenty-five day interval, painful. Polyuria. She used to work in a factory and her condition was normal until two months before when she suffered a sharp pain in the right iliac fossa, accompanied with chills, vomiting and constipation. Her condition returned to normal, the former syndrome reappearing three weeks later and with greater intensity. There remained after this attack pain in the right iliac fossa. These attacks of pseudo-obstruction repeated themselves, now finally arriving at a complete intestinal obstruction.

* Translated from the original Spanish by Dr. E. L. Faust. For Spanish text see p. 225.



FIG. 1. Congenital deformity of the intestine.

Exploration of the abdomen revealed a tumor in the middle toward the infraumbilical region, which was slightly movable in the transverse direction and completely immovable in the vertical, and completely dull to percussion. It gave the sensation that one was dealing with a definite tumor. There did not exist any sign to make one think of a lesion in the intestine; nor did there exist intestinal movements nor did the intestinal coils delineate themselves.

There was an eosinophilia of 8 per cent. Deviation of complement was negative.

The tumor was separate from the liver and from the spleen; it was not renal. It was not of the genital apparatus. All of it which was in the midline was surrounded by the large intestine. The diagnosis, although doubtful, we named as a tumor of the mesentery.

The valued opinion of Dr. Gallard who kindly studied the case decided us to intervene with all urgency, since the obstruction was becoming momentarily aggravated.

We made a midline incision from the xiphoid process to the pubis, showing the small intestine (Fig. 1) enormously distended, hard in consistency, all of the small intestine resolving itself into three loops which taken together corresponded to the tumor which was outlined from outside the abdominal wall. These three loops were surrounded by the completely empty large intestine. The superior extremity near the duodenal insertion and the inferior extremity near the cecal were explored and we noted a segment three fingerbreadths in length in the superior and five in the inferior which were completely empty, the latter being flaccid and the superior being distended, but without the hard consistency of the remainder of the intestine which gave the impression of being filled by a mass. The appendix was long. The mesentery glands were enlarged.

What procedure to follow in such a case? There remained only two solutions, to leave things as they were with absolute certainty of death by intestinal obstruction, or better still, if technically possible, to resect all of the small intestine, utilizing the superior and inferior two segments free of the lesion that was obstructing the intestinal lumen (a technique which the extreme mobility of the cecum facilitated permitting us at one time to resect the mass of the small intestine) and to approximate the terminal portion of the ileum to the upper part of the jejunum. The anastomosis was performed with two sutures, a sero-serosa and the other internal or perforating, the above union being protected by an omentoplasty. We ended by carefully suturing the mesentery (see Figs. 2 and 3) and removing the appendix.

The distance in the sectioned mesentery between the beginning of the jejunum and the end of the ileum was 15 centimeters, the length of all of the resected small intestine being 60 centimeters instead of the 5 meters,

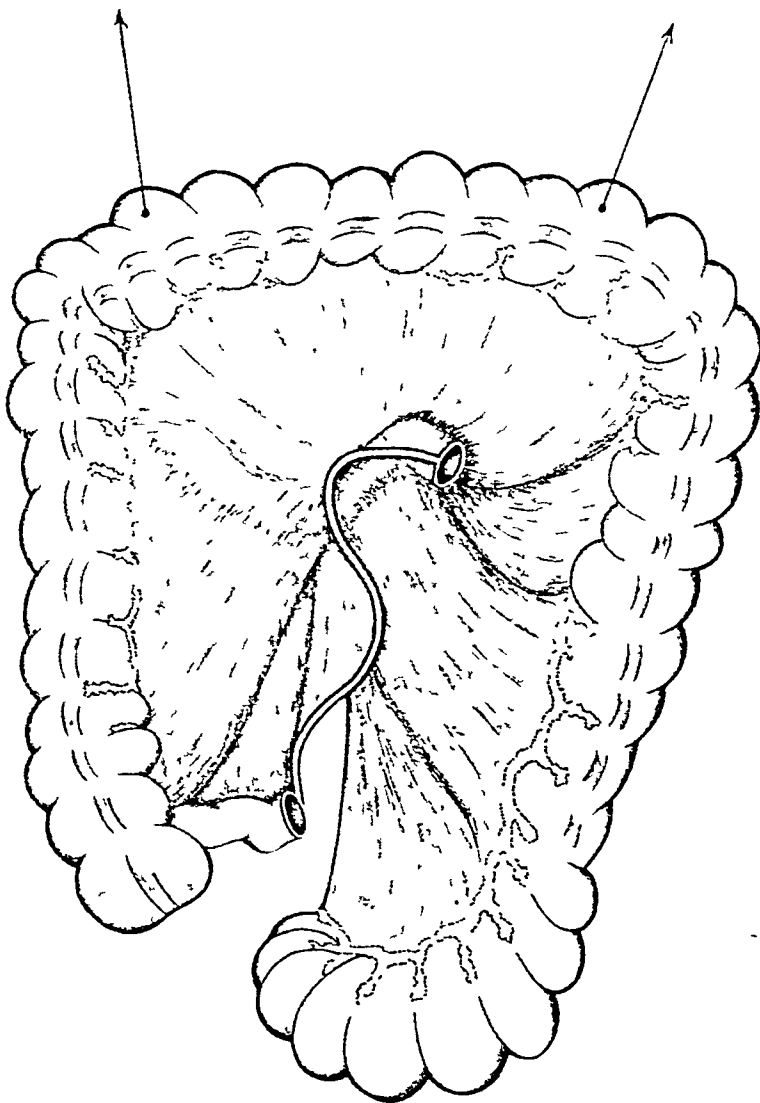


FIG 2

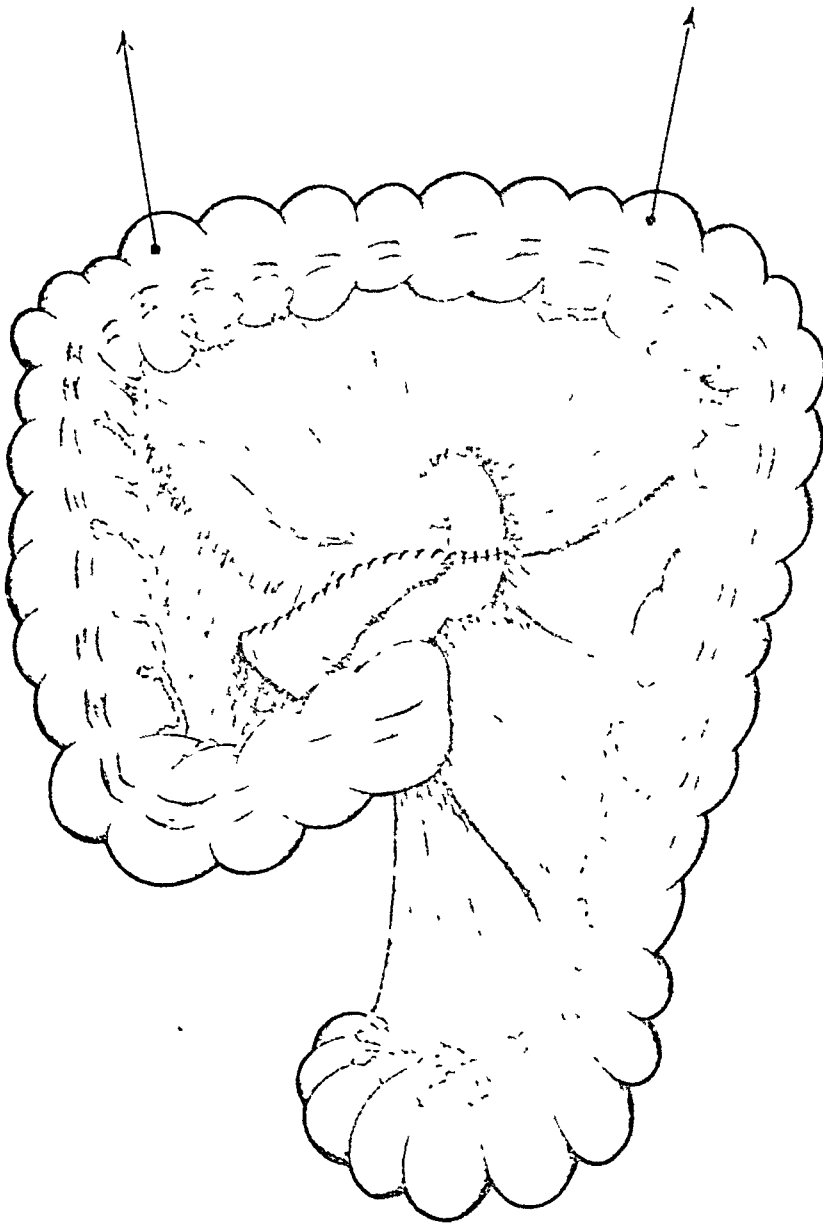


FIG. 3.

80 centimeters, to 7 meters, 80 centimeters which normally exist (Testut). We sutured the abdominal wall in three planes. The postoperative course was good.



FIG. 4.

The pathological specimen consisting of three intestinal loops was of a hard consistency and without intestinal lumen; in order to enlighten ourselves as to the cause of the obstruction we excised longitudinally the superior or jejunal end and with surprise saw that it was the intestinal mucosa (Fig. 4) itself which was filling the lumen.

The impression that this produced was that in the growth of the intestine the external coats suffered an interruption in their development while the internal or mucous coat continued its growth and development,



FIGS. 5 and 6. Study no. 509. Intestine. M. P. C.

FIG. 5. View in general of one of the multiple intestinal villi. 1, Intestinal lumen. 2, Cylindrical epithelial cells of the coat, completely normal. 3, Connective axes of the villi. 4, Lymphatic follicle (corresponding identically to the Peyer's patches of the normal intestine).

thus obliging the external tube formed by the serosa and muscularis to contain all of the mucosa which continued its normal growth until the time came when it completely blocked the intestinal lumen, causing the obstruction which necessitated surgical intervention. In Figures 5 and 6 can be seen the histologic preparations made by Dr. Fornells; aside from the slight sclerosis of the wall and muscular coat irregularly distributed, there existed a complete normality of the intestinal rugae and mucous patches.

Dr. Gallard arranged the postoperative regime and made repeated analyses which we give below.

The first postoperative week she took only milk, presenting a profuse



FIG. 6. Section performed on the sclerosed area in the intestinal wall. 1, Intestinal cavity (very much reduced). 2, Folds of mucosa, completely normal, which encroached on the intestinal lumen in a different plane to that of this section. 3, Fibrous connective tissue. 4, Muscular coat irregularly situated. No tissues are found which do not correspond to the normal structure of the intestine.

diarrhea with 7 to 8 movements daily. The analysis showed an insufficiency in the digestion of fats because of rapid passage since the bile and pancreatic lipase were normal.

In the second postoperative week milk was discontinued and she was admitted to a regime of cereals which she also did not tolerate. Opium was then administered and the movements were reduced from the 7 to 8 to only 2, the greater part of the carbohydrates being digested.



FIG. 7. M. P. C., child of thirteen years, operated upon with complete extirpation of the small intestine. Fifth week postoperative.

During the third week the cereal regime was continued with some egg and chicken. She continued taking opium with a fairly good digestion of carbohydrates, poor digestion of meat with a great number of muscle fibers in the microscopic examination. The opium was withheld; the diarrhea returned.

Fourth week: Opium and hospital half ration; 2 movements daily, sometimes formed and with moderate starch and yeast but with abundant muscle fibers.

Three analysis of the gastric juice were made:

First analysis: free HCl 0.36, total acidity 2 (abundant lactic and buturic acids).

Second analysis: free HCl —0, total acidity 4.17.

Third analysis: free HCl —0, total acidity 4.

Her general condition improved visibly until the fifth week after operation as can be appreciated by the accompanying photograph (Fig. 7). in view of which she was discharged and removed to her home, being advised to follow the prescribed careful regime. According to notices received, after she was away from Barcelona, the diarrhea became more frequent and she continued losing weight and five months after operation she died with cachexia from inanition.

In spite of the very essential part which the intestine performs in digestion, they have been able to extirpate a great part of the small intestine, up to 3 meters, without the disappearance of digestive functions supervening. This clinical case demonstrates in apparent manner that even the almost total extirpation of the jejunum and ileum permits a survival more or less long, depending on the physiological reserves, the more manifest the more rigorous the regime to which the individual is submitted. In our clinical case, while she was submitted to an adequate regime and during the time we were able to watch her, she gained visibly in weight; once removed to her home and the rigorous order to which she had been submitted was disturbed, there presented themselves sufficient complications of the intestinal physiology to finish the patient, there still being in spite of it her survival for five months. One thing we ought to make clear, and that is that despite the visible improvement experienced during the three months which followed the operation, she never recovered her appetite.

OBSTRUCCIÓN INTESTINAL POR DEFORMIDAD CONGÉNITA DEL INTESTINO DELGADO*

DR. E. RIBAS Y RIBAS

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ESTE caso clínico lo creemos por su rareza digno de ser publicado, ya que no hemos encontrado en la literatura ningún caso semejante y es tanto más notable cuanto en el acto de la intervención quirúrgica se nos planteaba un gravísimo problema y era o bien cerrar el vientre y condenar a la enferma a morir de obstrucción intestinal o bien extirpar todo el intestino delgado y exponernos a las graves consecuencias de la falta de dicho intestino que tan importante papel juega en la fisiología de la digestión. Entre la muerte inmediata por obstrucción intestinal y la probable pero más remota optamos por la extirpación de todo el intestino delgado, y confiar en suplencias fisiológicas por el intestino grueso. No sé la conducta que hubiera seguido otro cirujano. Yo creí obrar bien eligiendo el único camino que alimentaba una esperanza.

Caso clínico.—Mercedes Planas Carbonell. Ingresó en el Hospital de la Santa Cruz el 10 de noviembre de 1921 en mi servicio de Cirugía ocupando la cama n.º 28 de la Sala de San José. De 13 años de edad, natural de Sans y vecina de Badalona.

Padres fallecidos. Hermana sana.

Entre sus antecedentes patológicos: sarampión, tifoidea y viruela. Hace tres meses tuvo su primera menstruación a los 25, dolorosa. Polaquiuria. Trabajaba en una fábrica y su estado era normal hasta hace dos meses que sufrió fuerte dolor en la fosa ilíaca derecha acompañado de escalofríos, vómitos y estreñimiento. Se normalizó su estado, reapareciendo el síndrome anterior a las dos semanas y con mayor intensidad, quedando después de estas crisis, dolor en la fosa ilíaca derecha. Estas crisis de pseudo-obstrucción se repitieron hasta llegar a la obstrucción intestinal completa.

* For English translation see p. 215.

La exploración del abdomen acusaba una tumoración media e infraumbilical, tumoración dura poco movable en el sentido transversal y completamente inmóvil en el vertical, macidez completa a la percusión. Daba la sensación de que se trataba de una tumoración. No existía ningún signo que hiciese pensar en una lesión del intestino; ni existían movimientos intestinales ni se dibujaban las asas del intestino.

Existía eosinofilia de 8%. Desviación del complemento negativo.

La tumoración dicha está separada del hígado y del bazo; no es renal; no es del aparato genital. Toda ella, que está en la línea media, está rodeada por el intestino grueso. El diagnóstico aunque dudoso lo hicimos de tumor del mesenterio.

La valiosa opinión del doctor Gallard, que estudió el caso con todo cariño, nos decidió a intervenir con toda urgencia ya que el caso de obstrucción se agravaba por momentos.

Practicamos la laparatomía media desde el apéndice xifoides hasta el pubis, poniéndose de manifiesto enormemente distendido el intestino delgado (Fig. 1), de consistencia dura, reduciéndose todo el intestino delgado a tres asas y juntas simulaban la tumoración que se encontraba detrás de la pared abdominal, dichas tres asas estaban rodeadas del intestino grueso completamente vacío. Explorado el extremo superior o su inserción duodenal y el extremo inferior o cecal se notaba un segmento de tres dedos de longitud en el superior y cinco en el inferior que estaban completamente vacíos, estando flácido este último y distendido el superior, pero sin la consistencia dura del resto del intestino y que daba la sensación de estar relleno de una masa tumoral. Apéndice largo. Ganglios mesentéricos.

¿Qué conducta seguir en semejante caso? Sólo cabían dos soluciones: o dejar las cosas tal como estaban y con la absoluta seguridad de la muerte por obstrucción intestinal o bien ya que técnicamente era posible, reseca todo el intestino delgado aprovechando los dos segmentos superior e inferior libres de la lesión que obstruía toda la luz intestinal, técnica que facilitaba la extrema movilidad del ciego, y que nos permitió una vez reseca la masa del intestino delgado aproximar el extremo inferior terminal del ileón al superior del yeyuno. Practicada la anastomosis con dos suturas, una sero-serosa y otra interna o perforante, y protegida dicha unión con una plastia de epiplón, terminamos suturando cuidadosamente el mesenterio (véanse figuras 2 y 3) y extirpamos el apéndice.

La distancia del mesenterio seccionado entre el principio del yeyuno y el terminal del ileón era de 15 cm., siendo la longitud de todo el intestino delgado seccionado de 60 cm. en vez de los 5 metros con 80 cm. o 7 metros con 80 cm. que normalmente existen (Testut). Suturemos la pared abdominal con tres planos. Curso post-operatorio bueno.

La pieza patológica formada por tres asas intestinales era de consistencia dura y sin luz intestinal; para hacernos cargo de cual era la causa de la obstrucción incindimos longitudinalmente el extremo superior o yeyunal y con sorpresa vimos que era la mucosa del intestino (figura 4) que rellenaba toda la luz intestinal.

La impresión que producía era que al crecer el intestino sufrió un paro en su desarrollo, la pared externa, continuando el crecimiento o desarrollo de la pared interna o mucosa viéndose obligado el tubo externo formado por la serosa y muscular a contener toda la mucosa que continuó su crecimiento normal hasta llegar un momento en que tapó por completo la luz del intestino causa de la obstrucción que obligó a la intervención quirúrgica. En las figuras 5 y 6 pueden verse las preparaciones histológicas hechas por el doctor Fornells y que aparte ligera esclerosis de la pared y capa muscular desordenadamente distribuída, existe normalidad completa de las vellosidades intestinales y corpúsculos linfáticos.

El doctor Gallard formuló un régimen post-operatorio e hizo repetidos análisis que a continuación exponemos.

La primera semana post-operatoria tomó leche sola presentándose diarrea abundante, 7 a 8 deposiciones diarias. El examen coprológico demostró insuficiencia en la digestión de las grasas por travesía rápida, pues la bilis y la lipasa pancreática eran normales.

En la segunda semana post-operatoria se suprime la leche y se hace un régimen de feculentos que tampoco tolera. Entonces se le administra opio y las deposiciones de 7 a 8 bajan a 2, digiriéndose gran parte de los hidratos de carbono.

Durante la tercera semana sigue el régimen de feculentos y algún huevo y pollo. Continúa tomando opio, digestión bastante buena de los hidratos de carbono; mala digestión de la carne, gran número de fibras musculares al examen microscópico. Se suprime el opio; vuelve la diarrea.

Cuarta semana: opio y media ración del Hospital; dos deposiciones al día, algunas veces formadas con féculas y levaduras en regular cantidad con fibras musculares abundantes.

Se le hacen tres exámenes del jugo gástrico:

Primer análisis: CIH libre 0'36. Acidez total 2 (láctico y butírico abundantes).

Segundo análisis: CIH \approx 0. Acidez total 4'17.

Tercer análisis: CIH = 0. Acidez total 4.

El estado general mejora visiblemente a la quinta semana después de operada como puede apreciarse en la adjunta fotografía (Fig. 7), en vista de lo cual se le da el alta y es trasladada a su domicilio, encargando siga el riguroso régimen prescrito. Según las noticias recibidas, pues estaba

fuera de Barcelona, las diarreas se hicieron más frecuentes, fué perdiendo de peso y a los cinco meses de operada falleció de caquexia por inanición.

A pesar del papel esencial que desempeña el intestino en la digestión, se ha llegado a extirpar una gran parte del intestino delgado hasta 3 metros en el hombre sin que sobrevenga la desaparición de las funciones digestivas. Este caso clínico demuestra de modo ostensible que aun la extirpación casi total del yeyuno e íleon, permite una supervivencia más o menos larga, debida a suplencias fisiológicas, tanto más manifestadas cuanto más riguroso es el régimen a que se someta el individuo. En nuestro caso clínico, mientras estuvo sometida a un régimen adecuado y durante el tiempo que pudimos vigilarla, aumentó visiblemente de peso; una vez trasladada a su domicilio y descuidado el riguroso régimen a que se había sometido fuéronse presentando trastornos del fisiologismo intestinal hasta acabar con la enferma, siendo a pesar de ello la supervivencia de 5 meses. Un hecho debemos hacer constar, y es que a pesar de la visible mejoría experimentada durante los 3 meses que siguieron a la operación, nunca recobró el apetito.

CANCER IN THE NORTH AMERICAN NEGRO

FREDERICK L. HOFFMAN, LL.D.

NEWARK, N. J.

THE outstanding contribution to the study of benign and malignant tumors in the American Negro was made by Dr. Rudolph Matas in 1896, in a contribution to a treatise on Surgery by Frederick S. Dennis of New York City. Dr. Matas brought to bear upon his treatment of this interesting phase of the cancer problem an unrivalled experience, extraordinary powers of observation, and an impartial attitude of mind which gives to this production a lasting value in medical literature. I had in the same year published my "Race, Traits and Tendencies of the American Negro" including some fragmentary data on tumors, following an earlier discussion in my "Vital Statistics of the Negro" published in the *Arena* in 1892. But it was not until 1915, or twenty-three years later, that I was able to discuss the apparent frequency of cancer in the negro race, on the basis of more ample data, in my "Mortality of Cancer Throughout the World." But this discussion being incidental to a larger purpose was far from adequate to present the facts as they should be known and understood by all who may have occasion to come in medical or surgical contact with the negro race. For regardless of the clear-cut statement of Dr. Matas, serious misconceptions continue to prevail, as best illustrated by a discussion of "Malignant Disease in the Colored Race, with a Report of Two Cases,"¹ by Dr. August Schachner of Louisville, Kentucky.

Dr. Schachner introduces his subject with the remark that:

Two years ago a prominent surgeon of Louisville, now residing in an eastern city, asked me among a number of others who practice surgery as to whether I had ever operated upon a colored patient for carcinoma; if I had ever seen cancer in the negro. At that time I had not. In the same

¹*Am. J. Surg. & Gynec.* 1898-99.

conversation he said that another surgeon, perhaps the oldest in the city, stated that in twenty-five years he had not operated upon a single case of cancer in the negro. Aside from this particular instance I have frequently noticed that the impression seems to prevail rather generally that the negro is almost exempt from cancer.

Yet when this was written or said the lucid statements and data presented by Dr. Matas were available, while the statistics of the Board of Health of Louisville would readily have furnished a conclusive answer to the question raised. In fact Dr. Schachner refers to the observations of Dr. Matas, which made the statement quite superfluous and irrelevant. He himself concludes his remarks on just two cases with the admission that, "the negro does not enjoy the immunity to malignant disease which has been heretofore supposed."

The discussion following this paper throws little light upon the question under consideration. It is quite true, however, that previous to emancipation, the negro, by all the acceptable evidence available, was relatively much less subject to malignant tumors than the white race. The earliest evidence is to be found in De Sassure's "Census of Charleston, S. C." which includes vital statistics for the period 1822-48. According to this source, out of 8639 deaths from all causes among the white population, 61 or 0.7 per cent were due to cancer. Of the 11,220 deaths among the negro population, 50 or only 0.4 per cent were due to this cause. Both races, however, even for this early period show a surprisingly low incidence of malignant tumors in this section of the country, while likewise the mortality from benign tumors was only 7 for each race. Of course, the question of imperfect diagnosis must be readily admitted for this early period when cancers generally were often not recognized as such even by the best practitioners.

The next item of evidence is the medical experience of the Freedmen's Bureau, fortunately compiled and published in some detail by Dr. Robert Reyburn, Washington, 1891. In this experience there occurred 430,466 cases of disease, of which only 462 cases or 0.1 per cent were due to cancer. Out

of 18,027 deaths from all causes, only 62 or 0.3 per cent were attributed to malignant tumors, and 17 to benign tumors, a result conforming quite closely to the Charleston figures. I give some additional early data for a few cities and the state of Alabama in my "Race, Traits and Tendencies of the American Negro," concluding at the time (1896): "Tumors and cancers are less prevalent among the colored but on the increase among the population below the age of forty-five. Carcinoma uteri from which some writers suppose the negro to be exempt is prevalent though to a less extent among the colored population."

My own interest in the subject of negro mortality had been aroused by an extremely interesting essay on "The Future of the Colored Race in the United States from an Ethnic and Medical Standpoint" by Dr. Eugene B. Corson, a lecture delivered before the Georgia Historical Society, June 6, 1887. The address by Dr. Corson was probably the first systematic attempt to elucidate the pathologic divergencies of the two races and their bearing upon the future rate of increase and race maintenance.

In 1900 the Census Office published a monograph on mortality including white and colored cancer death rates of certain southern cities. During 1906-10, the average cancer death rate of Mobile, Alabama, was 84.8 per 100,000 for the whites and 59.7 for the negroes. For Charleston, the corresponding rates were 73.7 for the whites and 37.9 for the negroes, while for New Orleans the rates were 86.0. for the whites and 74.2 for the negroes, or not far from being identical.

The contrast in death rates becomes much more marked with later years, but it would be utterly hopeless to attempt a complete picture of the far-reaching mortality changes during the twenty-seven years since the Census Office reports have been published. It must suffice for the present purpose if I give only comparative rates for the two races for the year 1926, quite typical of present-day conditions. In that year the city of Mobile had a cancer death rate of 120.6 per 100,000

for the whites and 69.4 for the negroes. Charleston had a rate of 131.7 for the whites and 119.3 for the negroes, while New Orleans had a rate of 129.8 for the whites and 138.4 for the negroes. Thus the earlier conditions much in favor of the negro have largely disappeared from some of the principal southern cities typical of the negro population. Now, in some sections at least, cancer death rates for the negroes are in excess of those common to the white population.

In 1928 the United States Public Health Service issued an interesting bulletin on negro mortality from which I quote the following sentence: "Comparing white and colored curves, colored rates are higher than white up to fifty years of age and from then on are considerably lower than the white rates." But the data are somewhat conflicting when compared with those published by the Metropolitan Life Insurance Company in 1925 for the period 1911-1922. This is one of the most useful sources of information on negro cancer mortality ever issued and cannot be omitted from a discussion of the question. It gives detailed rates by divisional periods of life for all the seven principal divisions of cancer mortality. This investigation shows that the higher death rates from cancer among the negroes are limited to females for the age period under forty-five. But these figures are contradicted again by statistics published by the U. S. Census Office in 1927 according to which the rate for the negroes was less at practically all ages, with one unimportant exception, for males, but higher for colored females at all ages fifteen and over. It is difficult to reconcile these disparities which only add to the complexity of a more or less confusing situation. It may be pointed out, however, that the Metropolitan's experience with negroes is relatively limited, although fairly comprehensive for general purposes. Again the negro mortality of the registration area of 1926 does not include certain important rural sections of the South which might possibly modify the results. Combining all ages, and adjusting the rate for age and sex variations, the Census Office gives the following adjusted death rates for the two races:

white rate 93.8, colored rate 80.6 per 100,000. For males only, however, the respective rates are 81.7 for the whites and 48.1 for the colored, while for females the adjusted rate was 104.7 for whites and 109.6 for the colored. Hence the conclusion seems justified that negro females at the present time have a somewhat higher cancer death rate than white females and this applies specifically to all ages fifteen and over on the basis of the United States' experience.

In any event the conclusion is incontrovertible that the negro cancer death rate during the last generation has increased considerably and is probably not far from the corresponding increase in the white population, although it is possibly somewhat more. The next question which therefore arises is whether there are well-marked differences in the relative distribution of the cancer mortality in the different races by organs or parts of the body affected. Unfortunately the data on this phase of the problem for earlier years are too fragmentary to admit of entirely trustworthy conclusions. The earliest data are those derived from the Census of Charleston, but limited to cancer of the uterus. It appears from this compilation that out of 61 deaths from cancer among the whites, 9 or 15 per cent were carcinoma uteri, while out of 50 deaths from cancer among the negroes, 8 or 16 per cent were of this type. None of these deaths occurred, however, before 1841 among the negroes, and none of the white uterine cancers occurred before 1831. As thus measured, the susceptibility of the two races does not vary measurably for this early period, typical of conditions of slavery. Cancer of the uterus in both races in this section of the country seems to have been extremely rare.

But as I have said, all these earlier observations are of doubtful value in view of very probable diagnostic inaccuracies. I am limiting myself, therefore, to the most recent returns of the United States registration states, and shall point out the most significant divergencies in the cancer mortality of the two races. Among the males of the negro population in 1927-28, deaths from cancer of the buccal cavity formed 5 against 5.7

per cent for the whites. Cancer of the stomach and liver formed 44.0 per cent in the whites against 50.4 per cent in the negroes and cancer of the peritoneum, intestines and rectum formed 15.2 per cent among the whites and 12.9 per cent among the negroes. Cancer of the breast, which is very rare among the men in both races, formed 0.5 per cent in the negroes against 0.2 per cent in the whites. Cancer of the skin formed 3.6 per cent in the whites and only 0.2 per cent in the negroes, while cancer of other organs and parts, or not specified, formed 31 per cent in the white population and 29 per cent in the negro.

Coming now to females, the contrast is equally marked. Cancer of the buccal cavity prevailed to the extent of only 1 per cent among the whites against 1.4 per cent for the negroes. Cancer of the stomach and liver formed 30 per cent among whites against 20.8 per cent among the negroes. Cancer of the intestines and rectum amounted to 15 per cent for the whites against only 8.7 per cent for the negroes. The most marked contrast appears in cancer of the female generative organs which caused 24.4 per cent of the cancer deaths among the whites against 44.7 per cent among the negroes. I shall have occasion to refer to this outstanding aspect of the problem again. Cancer of the breast caused 18 per cent of the cancer mortality among white women against 14.5 per cent among negro women. Cancer of the skin, as in the case of males, shows a much higher proportion among white women, or 2.0 per cent, against 1.1 per cent among negro women. These are authentic results based on the total negro mortality from cancer during 1927 and 1928 of 11,587 deaths, or respectively 3588 in males and 7999 in females.

For purposes of comparison I made a like analysis of the cancer mortality of Indians but the numbers are too small for safe generalization. But I may state that of the cancer mortality of Indian women, 24 per cent were cancers of the female generative organs against 44.7 per cent for colored women. The percentage for cancer of the breast in Indian women was 10.6 against 14.6 for negro women.

Before passing to other observations it may be of interest to add a few remarks on the relative frequency of benign tumors. In 1927 in the registration states there occurred 636 deaths from benign tumors among both sexes of the white population, or at the ratio of one death from a benign tumor to every 150 deaths from malignant tumors. Among the colored population this ratio was one in 59. As I shall have occasion to point out later, benign tumors, especially of the uterus, are extremely common among negroes, so much so, that it is rare to find a negro woman over fifty years of age who has not some form of fibroid development of the uterus or generative organs otherwise.

There is thus an abundance of evidence that cancer is not only common among the negro population of the United States at the present time, but that certain types of cancer are more common among the negroes than among the whites. The official vital statistics in this respect are fully confirmed by those of the Metropolitan Life Insurance Company published by Dr. Louis I. Dublin in 1925. It is shown in this investigation that the rate of frequency of cancer of the buccal cavity is less common among negro males than among white males at ages above twenty-five, while it is more common among negro females at ages twenty-five to seventy-four than among white females. Cancer of the stomach and liver is excessive in negro males at all ages forty-four and over, and in women at all ages over thirty-five. Cancer of the peritoneum, intestines and rectum is less common among negro males at all ages, but more common among negro females at ages under forty-five. Cancers of the female generative organs are excessive at all ages among negro women, so much so, that the facts may be given in some detail. At ages twenty-five to thirty-four the white rate is 8.6 and the colored, 17.1; thirty-four to forty-four white rate 42.3, colored, 61.2; forty-five to fifty-four, white rate 83.7, colored, 104.3; fifty-five to sixty-four, white rate 105.8, colored, 136.0; sixty-five to seventy-four, white rate 120.6, colored, 146.1; seventy-five and over, white rate 113.4,

colored, 147.7. For all ages combined the white rate was 24.9 and the colored, 38.4.

Cancer of the breast is more common among negro males, prevailing at the rate of 0.2 per 100,000 against 0.1 for the whites. For the females the rate was 11.7 for the whites and 14.6 for the negroes. Here again I will give the detailed rates for females at different divisional periods of life. There were no deaths at ages under twenty-five. At ages twenty-five to thirty-four, the white rate was 2.4 and the colored, 3.6; thirty-five to forty-four, white rate 17.0, colored, 18.6; forty-five to fifty-four, white rate 38.1, colored, 40.0; fifty-five to sixty-four, white rate 51.6, colored, 61.0; sixty-five to seventy-four, white rate 73.9, colored, 89.2, seventy-five and over, white rate 105.5, colored, 128.8.

Cancer of the skin prevailed at the rate of 2.1 among white males and 0.7 among colored males. Among white females the rate was 1.6 against 0.8 for colored females. For other organs and parts, the white male rate was 13.5 and the colored rate 9.4. For females the white rate was 9.2 and the colored, 7.5. In 1925, in my second preliminary on the San Francisco Cancer Survey, I published a wealth of new material on the cancer mortality of New Orleans, differentiating throughout the two races and yielding some extremely interesting results. The investigation covered the four years 1919-1922. Unfortunately I have not as yet been able to bring that investigation further down to date. It was based on the critical examination of the original cancer death certificates furnished by the State Board of Health through the kindness of Dr. Oscar Dowling. The cancer death rate of the white population of New Orleans, as determined by this investigation for the years 1919-1922 was 125.3 per 100,000, while that of the colored population was 121.8. That of white males was 127.3 and that of colored males was 112.8. That of white females was 123.3 and that of colored females was 129.6. The detailed tables give rates by ages but it would hardly serve a practical purpose to enlarge upon this phase of the question.

The average age at death was 57.3 years for the whites against 48.1 for the negroes. For white males the average age at death was 58.1 years against 50.8 years for colored males, while for females the average for whites was 55.8 years against 47.1 for the negroes. The average known duration of the disease was 1.5 years for the whites and 1.0 years for the negroes. Of the whites, 44.3 per cent had been operated upon previous to death, but among negroes this proportion was 16.8 per cent. Among the whites, 2.9 per cent had come to autopsy and among the negroes this proportion was only 1 per cent. Of the white deaths from cancer, 33.2 per cent occurred in hospitals and for the negroes this proportion was 40.6 per cent. For the whites no ascertainable method of diagnosis was stated in 63.4 per cent of the cases and for the negroes this proportion was 77.6 per cent. Microscopical diagnosis was made in 4.4 per cent of the cases among whites, while among the negroes this proportion was 1.3 per cent. The average length of residence in New Orleans had been 44.8 years for the whites and 41.7 years for the negroes.

By specific organs and parts, the distribution was as follows, combining males and females. The proportion of deaths from cancer of the buccal cavity among the whites was 16.8 against 6.9 per cent for the negroes; stomach and liver, whites, 29.5, negroes, 31.1 per cent; peritoneum, intestines and rectum, whites 9.8, negroes 12.2 per cent; female generative organs, whites 16.0, negroes 29.1 per cent; breast, whites 8.4, negroes 8.6 per cent; skin, whites 0.6, negroes 0.5 per cent; other organs and parts, or not specified, whites 18.9, negroes 11.5 per cent.

In my third report on the San Francisco Cancer Survey, published in 1927, I give the death rates for the two races for New Orleans for the period 1919-1923 in considerable detail. I will single out a few of the most significant items (rates per 100,000 of population).

Cancer of the lips among the whites prevailed at the rate of 0.3 against a rate of 0.4 for the negroes, and cancer of the tongue 3.5 for the whites and 1.0 for the negroes. This is

extremely interesting in view of the alleged correlation of syphilis to cancer of the tongue, since it is well known that the negro race is very much more subject to syphilis and other venereal diseases than the whites. For males only the white rate from cancer of the tongue was 6.4, while for colored males it was only 1.2. Cancer of the mouth prevailed at the rate of 0.6 for the whites and 0.4 for the negroes; cancer of the jaw, white rate 1.5, negro 2.3; cancer of the throat, white rate 1.4, negro 0.2; neck, white rate 2.9, negro 0.4; face, white rate 4.0, negro 1.5; eyes, white rate 0.5, negro 0.2; nose, white rate 0.5, negro none; ear, white rate 0.3, negro 0.4; head, white rate 0.3, negro 0.2; tonsil, white rate 0.1, negro 0.2; cheek, white rate 0.3, negro, none; pharynx, white rate 0.5, negro, none; esophagus, white rate 2.3, negro 0.2; stomach, white rate 23.0, negro 23.6; liver and gall bladder, white rate 10.3, negro 9.0; mesentery and peritoneum, white rate 1.4, negro 1.1; intestines, white rate 6.7, negro 5.3; rectum and anus, white rate 2.9, negro 6.3.

For the female generative organs, cancer of the ovaries prevailed at the rate of 2.4 among the whites and 2.9 among the negroes; cancer of the uterus, white rate 32.0, negro 52.9; vulva and vagina, white rate 0.9, negro 1.1; others of this class, white rate 0.5, negro 0.4. For cancer of the breast, both sexes, the white rate was 9.5 and the colored 9.0. For women separately, the white rate was 18.8 and the colored rate 16.8. For cancer of the skin the white rate was 0.7 and the negro 0.6; cancer of the larynx, white rate 2.8, negro 0.4; lung and pleura, white rate 2.8, negro 0.6; pancreas, white rate 0.8, negro 0.4; kidneys, white rate 1.3, negro 0.2; prostate, white rate 3.0, negro 0.8; for male population only, white rate 6.1, negro 1.6; cancer of the bladder, both sexes, white rate 4.3, negro 2.3; brain, white rate 1.1, negro 0.8; bones, white rate 2.4, negro 3.4; testis, white rate 0.1, negro 0.8; penis, white rate 0.3, negro 0.6; heart, white rate 0.1, negro, none; all organs and parts combined, white rate 112.8, negro 105.0;

males only, white rate 106.0, negro 79.8; females only, white rate 119.0, negro 126.4.

My report for New Orleans includes a mass of details as to the age at death for particular organs and parts, and the known duration of the disease. But this I will not enlarge upon for the present. I regret that my investigation did not separate sarcomas from carcinomas, but that would have very much complicated the work for which the facilities were very limited. The results in a general way confirm previous investigations and clearly emphasize the higher death rates from cancer from certain organs and parts among the negroes, particularly among negro women. Upon this phase of the problem the essay by Dr. Rudolph Matas published in 1896 furnishes the most conclusive answer. Dr. Matas considers such questions as race amalgamation, environment, anatomical peculiarities, physical characteristics, and pathological characteristics. Dr. Matas' observations are based almost exclusively upon the experience of the Charity Hospital for the period 1884-1893. In my second San Francisco cancer report, I give a supplementary table of the Charity Hospital experience 1916-1923, limited to carcinomas, epitheliomas and sarcomas in the surgical and gynecological divisions, with distinction of race. It brings out certain additional peculiarities of the negro, particularly his so much higher liability to sarcomas, apparently more common in the negro than in the whites. Thus there is reported a higher death rate from cancer of the bones among the negroes in New Orleans general mortality experience. The observations by Dr. Matas on tumor formation in the white and colored races are classical but cannot be abbreviated to advantage. With reference to benign neoplasms, however, he observes: "That this is a most fruitful field of investigation for the racial pathologist is proved by the constant and unfailing reference made by all writers on the subject to the much greater tendency displayed by the colored race to the development of certain types of benign growths, such as keloid and fibroid." This statement is confirmed by other

studies of tumors in negroes, whether in this country or in Africa or the West Indies. Dr. Matas observes in this connection on the basis of the Charity Hospital statistics that:

This clearly shows that fibroids, alone or associated with histoid elements of the same embryological derivation (mesoblast), occurred five times more often in the colored than in the white. And, curiously enough, the mortality is exactly proportional to the prevalence, and is five times as fatal in this race. The excessive mortality is due no doubt to the great preponderance of aggravated and neglected uterine fibroids which are usually admitted in the hospital in the most advanced and incurable stages of development.

Regarding malignant neoplasms, Dr. Matas gives expression to the opinion that:

It would appear from all this and other evidence that the opinion which has long existed that the negro was formerly less liable to malignant disease, and especially as to true cancer, is founded on some ground, though it is equally certain that at present cancer affects the races in the same proportion. But our hospital statistics go further than this, and indicate a greater prevalence of cancer among the colored patients. As they faithfully represent the experience furnished by this institution, they are worthy of serious consideration.

The foregoing observation is fully confirmed by the preceding statistical analysis of the general mortality of the country, as well as the correlated mortality experience of the Metropolitan Life Insurance Company. It is only for me to add the remark by Dr. Matas that, "The summary of this table shows that sarcoma is both more frequent and more fatal in the negro."¹ To this observation I add Dr. Matas' concluding remarks which are highly significant:

That the tendency to the formation of neoplastic tissue whether purely hyperplastic or heteroplastic is greater in the negro than in the white race.

2. That the typical mesoblastic derivatives of the adult connective tissue group are especially prone to develop in the negro.

¹ In the Charity Hospital experience, 1916-1923, out of 1307 white surgical cancer cases, 161 or 12.3 per cent were sarcomas, and out of 833 colored surgical cancer cases, 264 or 31.4 per cent were sarcomas.

3. That of this group, the fibroma and cicatricial keloid preponderate sufficiently to give to the black race a striking pathological peculiarity.

4. That the mesoblastic derivatives of the embryonal connective tissue type, i.e., the sarcomata, are also apparently more frequent in the negro, with the sole exception of the melanotic sarcomas, which are rare.

5. That contrary to the generally accepted belief, the epiblastic derivatives of embryonal type, or the true cancers, appear, statistically at least, to be even more common than in the white race.

6. That in regard to the malignant neoplasms the negro constitution has probably undergone some change under the conditions of American civilization, since it cannot be doubted that cancer is comparatively rare in the native African, rare also in the original slave population of this country, and has only become a common disease in the American negro of the last few generations. It is also probable that the conditions that are causing an increase in the prevalence of cancer among the whites are also acting with the same effect upon the negroes.

It had originally been my intention to have included in these observations some extended statistics from Africa and the West Indies, but to enlarge upon this phase the subject would carry me too far and exceed the permissible limitations of space. I have studied the cancer problem in Haiti and obtained some interesting data from that source, including the last and admirable report of Commander K. C. Melhorn, Commissioner of Health, in Haiti. This report contains some statistics of interest but of limited value in view of the large proportion of ill-defined, or not specified, diagnosed causes of death. The statement has been made that cancer is equally common in Haitian natives as it would be in a like proportion of the white population. But with this conclusion, I am entirely in disagreement. In the mortality report for 1927, for example, out of 12,868 deaths, only 47 are attributed to cancer. Of these, three were of the buccal cavity, 14 cancer of the stomach and liver, 1 cancer of the intestines, 8 cancer of the uterus, 9 cancer of the breast, and 12 cancer of other organs and parts. That cancer does occur among Haitian natives of practically every type may be readily admitted for the Haitian Hospital has an excellent personnel and makes frequent microscopical examinations of tissue. But considering the large number of

patients under treatment at the local infirmaries and dispensaries throughout the Island under American administration, the actual number of cancer cases reported is very small. The Haitian Medical Service last year furnished me with diagnostic cards for 85 patients, which as far as I know represent all that have been subjected to microscopical examination. Of these 85, 44 were males and 24 were females, while in 17 cases, the sex was not defined. Of the 85 cases, 12 were diagnosed as sarcomas, including 5 diagnosed as fibroid sarcomas. Practically almost every organ or part of the body was included in the cases under review, suggestive of the conclusion that cancer is relatively frequent in Haiti, certainly in the town populations. But concluding from my own observations of life in Port-au-Prince, I see no reason why this should not be the case for the natives of Port-au-Prince live much like the negro population of New Orleans and other large southern cities. The inadequacy of the 85 cases for definite conclusions is best illustrated by the fact that not one of the deaths was from cancer of the stomach, and only one was from cancer of the uterus, but there were 21 cases of cancer of the breast, including 3 cases in males. There were 6 cases of cancer of the penis which is said to be rather common.

I have also compiled the statistics of cancer in the Virgin Islands on which an interesting report has been published.¹ Of the deaths reported, 5.3 per cent were of cancer of the buccal cavity against 2.7 per cent in the American negro. Cancer of the stomach and liver formed 31.4 per cent in the Virgin Islands against 30.4 per cent in the American negro. Cancer of the peritoneum and intestines formed 5.3 against 9.2 per cent, cancer of the generative organs 23.7 against 30.8 per cent, and cancer of the breast 5.3 against 9.9 per cent. There were no deaths from cancer of the skin. Cancer of other organs and parts formed 28 against 15.5 per cent for the American negro. The mortality, however, is too limited, and as in the Haitian report represents probably exclusively a town population.

¹ *U. S. Natl Med. Bull.*, 20:31 (Jan.) 1924.

Before continuing with the preceding observations, I wish briefly to call attention to an interesting book on "Practical Rules for the Management and Medical Treatment of Negro Slaves in the Sugar Colonies" published by a Professional Planter, London, 1811. It contains an interesting discussion of diseases of negroes but absolutely void of any reference to malignant tumors. The writer observes that few of the medical men at the time had devoted their pens very particularly to the subject of negro disorders, which, unfortunately, is true even at the present time regardless of the large negro population of this country. For unless the negro is studied in the manner of Dr. Matas with reference to his anatomical, pathological and possibly physiological peculiarities, the subject of negro health cannot possibly reach the same status as is true of the white population. As far as I know the only strictly scientific attempt in this direction is the practically unknown treatise on "The Comparative Anatomy and Psychology of the African Negro" by Herman Burmeister, translated by Dr. Julius Friedlander and Dr. Robert Tomes, published first in the *New York Evening Post*, and subsequently republished in pamphlet form, New York, 1853. It is regrettable that such studies could not have been continued on a much larger and more comprehensive scale in view of the vastly greater material now available for the purpose. But Burmeister was concerned rather with anatomical and anthropometric variations in the two races than with pathological and physiological differences which unquestionably bear directly upon disease predisposition and disease liability.

Returning now to the occurrence of cancer among the negroes of the West Indies, I may refer to a discussion on "Cancer in St. Croix, Virgin Islands" by Dr. C. B. Van Gaasbeek, Lieutenant, M. C., U. S. N.¹ This paper is based on two and one half years' observations on the part of a qualified observer, while the statistics were obtained from the clinical records of the Christiansted and the Frederiksted Municipal

¹ U. S. Naval Med. Bull., 20: 31 (Jan.) 1924.

Hospitals, amplified by the official death certificates and the writer's own observation of some of the cases. He states that:

During the past two and one-half years, i.e., from January 1, 1921, to July 1, 1923, among the 5,720 patients treated in the hospitals on the island there have occurred 15 cases of cancer. Of these, 2 cases may safely be disregarded, since the diagnoses were evidently erroneous, and a third case was very doubtful. One case diagnosed carcinoma of the stomach proved on autopsy to be gastric ulcer. The second case was diagnosed carcinoma of the testis with metastases to the inguinal glands. In this case the testis and some of the glands were removed. The operative wound later broke down and gonococci were obtained in the discharge. This patient is living and well two years later. The third case was diagnosed gastric carcinoma on clinical signs alone.

Of the 14 authentic cases of cancer, the distribution was as follows: 4 epitheliomata, including 1 of the tongue, 2 of the face, and 1 of the anus; 3 carcinomata of the breast; 5 carcinomata of the uterus; 1 carcinoma of the liver, metastasized from the head of the pancreas; and 1 carcinoma of the stomach.

The age limits varied from 19 years to 87 years, with an average age of 51.1 years. The youngest was the epithelioma of the anus and the eldest was an epithelioma of the face.

With reference to the population of St. Croix, he remarks:

The majority of people of St. Croix are negroes. They are poor and for the most part ill fed, living upon fungi and fish, and are consequently poorly nourished. Smoking has always been common. The clay pipe is generally employed for this purpose. It is probable that their physical condition, habits, and mode of living exempt them in a large extent from cancer.

Of the 14 cases, 11 occurred in people somewhat above the average of field laborers, both in living and eating. This fact would make it appear that people living under primitive conditions are relatively immune to cancer. He quotes Williams to the effect that: "Cancer was rare among people predominately poor and of necessity frugal, subsisting on an alimentation comprising but little protein food."

Referring to Pitchford's observation that "the increase in cancer is due to the diminution of protection to light and the increased exposure to illumination," he holds that dark-

skinned races on this account are less liable to malignant disease than white races in the tropical and semitropical climates. He therefore arrives at the final conclusion that,

The people of St. Croix appear to be relatively less susceptible to cancer probably because of (1) their black color protecting them from the rays of the sun, the darker the individual the greater the protection; (2) simple diet, especially lacking in the highly seasoned protein foods; (3) lack of alcoholism; (4) non-use of powders and in many cases of soap; (5) and especially their physical conditions and modes of living.

Unfortunately Dr. Gaasbeek did not continue his study probably because of transfer to other parts. In the meantime, however, Dr. R. M. Choisser, Lieutenant Commander, M. C., U. S. N., has contributed an important study based on a review of 700 consecutive autopsies in Haiti. It was my privilege to meet Dr. Choisser in Haiti and he favored me with some of his observations. I heard his paper on the first 300 autopsies read before the Haitian Medical Society at Port-au-Prince in March, 1928. In that analysis he shows that 31.6 per cent of the deaths were due to pulmonary tuberculosis. As regards dietary habits of the peasant Haitians, he observes that as a rule they eat rather coarse, highly seasoned food and in the majority of instances imbibe freely of strong alcoholic drinks. At the same time it is thus found that these habits did not apparently predispose the native Haitian to gastric ulcer. Diseases of the liver in Haiti are rather rare. Diseases of the genitourinary system, however, are quite common. Chronic interstitial nephritis leads the list with 8.7 per cent of the total. The ratio of cases of endocarditis, both specific and non-specific, was found to be relatively very low. Passing over other diseases, I shall briefly quote some of his observations on malignancy. He remarks:

It is the general consensus of opinion that cancer is extremely rare in people of the African race. I am thoroughly convinced from our necropsy findings and examinations of microscopic specimens from biopsies that this view is a misconception. The low mortality rate from cancer in the

Tropics is, in my opinion, due to a lack of scientific study rather than to a rarity of the disease itself. It is readily accepted, among both the laity and medical profession, that benign tumors such as keloids, lipomata, and fibromatoma, are quite common in the Tropics. These tumors are usually very large and make their presence known by their size alone. As the benign tumors are known to be common, it is only reasonable to assume that cancer should also be present. The fallacy arises not from any rarity of cancer, but from the lack of autopsies and a careful search of microscopic sections from suspicious tumors. Cancer is a universal disease and all races, whether primitive or otherwise, are susceptible, irrespective of the climate in which they live.

With some of the foregoing observations I cannot agree. In the first place, it does not necessarily follow that because benign tumors are common that malignant tumors must likewise be common. For conversely, while benign tumors are quite rare in civilized populations, malignant tumors are certainly most common and becoming more so. Nor do I agree with him that the apparent rarity of cancer in the tropics is due to the lack of scientific skill or interest in the correct ascertainment of malignant tumors. There are certainly countless localities and sections in the Tropics which for all practical purposes must be looked upon as thoroughly civilized and yet the incidence of cancer in these localities or sections is surprisingly low. Cancer is not necessarily a universal disease, but it is tending to become such as the result of modern habits of living, yet there are whole regions of the earth in which cancer is comparatively rare and in no part of the world does this apply more than the Continent of Africa. Even in Haiti, Dr. Choisser's own investigations revealed only 27 deaths from cancer in the records of the hospitals, or 3.85 of the total cases considered. Three of these were cases of sarcoma and 24 of carcinoma. Out of a series of 486 consecutive biopsies from specimens received from various parts of the Island, 75 or 15.4 per cent were found to be malignant. The cancers found in microscopic sections from tumors removed at operation were as follows; adenocarcinoma, 32; squamous cell carcinoma, 24; basal cell carcinoma, 5; pigmented melanoma, 3; non-pigmented melan-

oma, 3; lymphoblastoma, 2; and fibrosarcoma, 6. One interesting point was that in all of the cases of non-pigmented melanoma the original growth was on the heel.

I agree with Dr. Choisser that: "The above figures certainly do not show the African race to be immune to cancer, but they do suggest the possibility that the black man may possess a certain immunity to the metastatic distribution of malignant cells, a condition not found in those of Caucasian descent." But I would go further and maintain that in my judgment in primitive African races there is a comparatively very high degree of immunity to all forms of cancer, the development of malignant tumors being proportionate to the degree under which such races assimilate the habits and ways of living of races more civilized.

To the foregoing I will add a few brief abstracts from fragmentary references regarding cancer in the African negro or otherwise. Dr. N. Macvicar, in the South African Medical Record for 1925, gives an analysis of data relating to about 10,000 South African natives treated as hospital in-patients. Among these, the author found 97 cases of carcinoma, 30 of sarcoma, and 14 of tumors in internal organs not diagnosed or verified at operation or necropsy but probably malignant. Cancer of the mouth seems to be fairly common, which he also attributes to irritation caused by the various things that native men and women carry in their mouths, especially plugs of coarse tobacco. Cancer of the liver is apparently common among comparatively young men and even boys, and this it is suggested may be due to schistosome infection. On the other hand cancer of the breast seems to be rare. This the author was inclined to attribute to the fact that in their natural state Bantu women do not wear corsets and rarely do so even when they have adopted other European clothing. Further, he believes that the few natives who did wear the high ribbed corset of the last generation suffered as commonly as European women from breast cancer.

W. W. Pittsford¹ comments on the prevalence of cancer among the native races of Natal and Zululand. According to the abstract in the *Cancer Review*:

The author states that during the four years 1906-9 there were reported 8 deaths from cancer among the whole native population (nearly one million) of Natal and Zululand, giving a crude death rate of about 0.21 per 100,000 per annum. During the same period the reported average annual death rate from cancer among the Indian immigrants was 11.9 and among the Europeans 57.5. The cancers were of the breast, liver, stomach, and glans penis; in addition, of 39 tumour specimens from living natives, submitted for examination, 18 proved to be benign tumours, 9 sarcoma, 9 carcinoma, 1 rodent ulcer, 1 intracystic papiloma of the breast, and 1 compound parotid tumour.

In the same year, Dr. E. D. Pridie writes on "Malignant Disease in Native Races of the Sudan."² According to the reviewer:

The author states that among the primitive Hadenowa tribes of the Sudan, malignant disease seems to be very rare. During a year he saw in the whole Red Sea province only two cases, one of epithelioma of the vulva and the other of a malignant parotid tumour. Among the Sudanese natives generally, the commonest form of malignant disease is carcinoma of the breast, but benign tumours such as lipoma and fibroma are fairly common. These tribes live an isolated life, scattered over a wide area in dry desert land rising to 6000 feet in the hills along the Red Sea coast. They subsist mainly on the milk of camel, goat, sheep or cow, with small amounts of millet and meat. The milk is drunk cold, and the millet and meat are cooked. Constipation is very prevalent; circumcision is practiced; deficiency diseases are practically unknown, and diseases aggravated by insufficient diet are rare.

In the Annual Medical and Sanitary Report of Nigeria for 1925, published, Lagos, 1926, according to the *Cancer Review*, it is shown that:

Among the tumours in natives recorded are: (1) a rapidly growing inoperable sarcoma of the superior maxilla and orbit; (2) sarcoma of the foot; (3) epithelioma of lower lip, in male, aged 58; (4) carcinoma of breast, in woman, aged 50; (5) inoperable carcinoma of caecum, in a

¹ *M. J. South Africa*, 1925.

² *Brit. M. J.*, 2: 649, 1925.

woman aged 50; (6) melanotic sarcoma of groin in a male, aged 40; (7) adenocarcinoma of both ovaries; (8) lymphangioma of face; (9) inoperable tumour of pylorus—microscopical examination at autopsy showed small-celled carcinoma difficult to distinguish from sarcoma; (10) inoperable carcinoma of cervix; (11) periosteal sarcoma of tibia; (12) basal-celled epithelial growth of cheek in boy, aged 14; (13) fibrosarcoma of jaw; (14) mixed-cell sarcoma of femur; (15) lipoma of shoulder.

Thus out of 15 cases, 6 were sarcomas, possibly 7, an extraordinary proportion, yet relatively common to African natives.

In the annual report of the Medical Research Laboratory for the year 1924, published Nairobi, 1926, according to the *Cancer Review*, it is said:

Of great interest is the increasing number of malignant tumours from natives, almost all from natives untouched by civilization living a primitive life in the native reserves. Such observations are of value in view of recent statements both in England and America that "cancer" is a disease of civilization, brought about by modern food and that it is unknown in primitive tribes. Certainly in the past very little malignant disease has been reported among primitives, but is this not due to the scant medical attention they receive? The increase in the number of malignant tumours in the last few years in Kenya is marked and coincides with the opening of hospitals and dispensaries in the native reserves and the increased interest taken in the medical welfare of the native.

But the actual figures are so small as to justify no such far-reaching conclusions. In 1922, for example, 5 malignant specimens were received in the laboratory, 5 in 1923 and 17 in 1924, which considering the enormous native population in Kenya is wholly insignificant and not an index of relative frequency. The 17 specimens considered in 1924 included a gland from the neck, carcinoma of the stomach, larynx and breast, metastatic carcinoma of the liver, metastatic sarcoma, lymphosarcoma of kidney, spindle-celled sarcoma, large spindle-and giant-celled sarcoma, large round-celled sarcoma, and fibrosarcoma. Here again out of 17 cases, 6 were due to sarcomas which represents a proportion never met with in civilized populations. Since sarcomas, carcinomas and epitheliomas are unquestionably due to different causative factors, a clear

distinction must be made in their relative frequency, which unfortunately is not easily ascertainable even for civilized countries which publish statistics of cancer but do not give separate information for sarcoma. But all the investigations thus far made show conclusively that sarcomas are relatively much more common among primitive populations than among populations considered civilized.

The Annual Medical Report of the Tanganyika Territory for the year ending 1925, reviewed in the *Cancer Review* of 1927, contains an interesting note by Dr. E. L. Kennaway reading as follows:

The following cases of malignant disease, verified by microscopic examination, in natives are described: (1) sarcoma of eye in child, aged 3; (2) mixed-celled sarcoma of scapula; (3) 3 cases of epithelioma supervening upon chronic ulcer of leg (this condition appears to be of rather frequent occurrence in African natives); (4) fibroscaroma of temporomaxillary joint; (5) inoperable spheroidal-celled carcinoma of breast in a Chagga woman, aged 40; (6) 2 cases of primary carcinoma of liver. Paget's disease was diagnosed in a woman who refused operation. Dr. J. H. Parry (Medical Officer, Moshi) remarks, "I do not believe that malignant disease is so uncommon as it is stated to be among the uncivilized Africans, and because of this belief many cases no doubt have been overlooked in the past. Why is primary carcinoma of the liver so common in the African when it is such a rare disease in Europe?"

I am quite ready to agree that malignant disease in all probability is more common among uncivilized African natives than is generally known or can be proved on the basis of statistics but the relative frequency in my judgment is exceedingly low while the overshadowing importance of sarcomas presenting the matter in a totally different light than the cancer problem affecting the negro population of this country.

In the Annual Report of the Government of the Gold Coast for 1925-26, according to Dr. Kennaway, occurs the following mention of cancer in African natives.

There have appeared at various times recently somewhat erroneous statements as to the absence of malignant disease in the African native. The majority of the cases mentioned here are from the so-called "Bush

native" in contradistinction to the town bred educated African. The tumors enumerated are spindle-celled sarcoma (4); round-celled sarcoma (4); melanotic and lymphosarcoma (1 each); sarcoma of neck in children (2); carcinoma of breast (3, of these 1 in a male); carcinoma of cervix and of stomach (1 each); epithelioma of lip (3), leg (1) and penis (1); and some innocent tumors.

Dr. Kennaway in this connection observes that in connecting *Bilbarzia* with cancer of the bladder the following passage from this report is of interest: "One female . . . had numerous ulcerations of the vulva. The Wassermann was negative. A tag from one of the ulcerations was then sent for histological examination and revealed the ova of *Schistosomum haematobium* in large numbers. It is possible that *Bilbarzia* may account for many of these apparently venereal ulcerations." I have dealt elsewhere with the exceptional frequency of cancer of the bladder in Egyptian natives in an address delivered before the Cancer Research Society on April 16, 1930, so I will not enlarge upon this phase in the present discussion.

In the *Cancer Review* for 1927 is also a brief note by Dr. C. E. Dukes reviewing some observations of Surmont and Sava on cancer among the native races of Africa in the French Review of Cancer for the same year. He remarks:

French and Belgian doctors who have lived for long periods in Africa have repeatedly reported different innocent and malignant tumors which they have met with in their practice, and the authors have gone through some of these records (though obviously only a small proportion) and summarized them in this paper. The only conclusion in relation to cancer to be drawn from the facts reported is that all the common varieties of malignant disease known to exist among white races are known to exist also among the black.

With this conclusion I am in entire agreement except as to the relative degree of frequency. I have never maintained that cancer does not occur in primitive races, but I have always maintained that it occurs as a rare incident rather than as a matter of frequency common to the white population.

The immense divergencies in the distribution of cancer by organs and parts in native races from those called civilized are of the utmost importance. Nothing in this respect is more illuminating than the frequency of cancer of bladder in Egyptian natives due to *Bilbarzia* infection. Here there is an isolated factor which accounts for a particular form of cancer not met with in the white population. Even more important is the excessive frequency of sarcoma among African natives for which thus far not a single acceptable conclusion has been advanced.

In the *Kenya and East African Medical Journal* for 1927, is a brief report on carcinoma in Africans, reviewed by Dr. Kennaway in the *Cancer Review* of 1928 as follows:

A report of six cases. "In view of the tradition that carcinoma is very rare amongst African natives, it is always worth while to record such cases as are from time to time reported." Cases 1, 2 and 3, ulcerating epithelioma of foot, of abdominal wall, and of breast, respectively; 4, medullary carcinoma of breast (male); 5, carcinoma of nose; 6, squamous-celled carcinoma of oesophagus. In all these, microscopic examination was made. Cases 1-5 were from Coast tribes, case 6 was a Kavirondo.

In the same journal is a review by Dr. Kennaway of an address by Dr. C. F. Beyers¹ on the incidence of surgical diseases among the Bantu races of South Africa. From this review I quote the following extract with the writer's observations:

A study of 18,000 Bantu in-patients admitted between 1921 and 1926 to the Johannesburg Hospital, which draws its patients from a population of about 200,000 of that race. The occupations of the adults are mainly those of labourer or domestic servant. The sites of the carcinomas were as follows: liver, 22; uterus, 12; breast, 11; (3 in males); stomach, 7; skin, 5; colon, 4; oesophagus, 3; bladder, 2; parotid, pancreas, pharynx, peritoneum, kidney, penis, thyroid, lung, larynx, 1 each.

Here again we have a totally different site distribution than would be common to a white population, suggestive of totally different conditions likely to foster or develop malignant growths in South African natives. Dr. Kennaway mentions

¹ J. M. Assoc. So. Africa. 1927.

that the author quotes four other collections of data on malignant disease in South African natives and he states that these figures agree with his own in showing "(1) a predominance of carcinoma over sarcoma; and (2) a very high proportion of cancers of the liver, which constitute in most series from 20 to 50 per cent of all cancers. Carcinoma of the uterus comes next in order of frequency among Bantus. The author concludes (1) that cancer is a rare disease among Bantus, and (2) that cancer does not appear to be more common in town-dwelling natives than among country natives." Dr. Kennaway observes that the author does not recognize that a comparison of the age distribution in Bantu and white populations is required, but in my judgment this would not very materially alter the results.

I will not further enlarge upon the foregoing type of data except to add a brief review of a discussion of cancer in primitive negro tribes by E. Maass, in a German periodical on Tropical Hygiene, Pathology and Therapeutics of Disease, 1928. The author apparently is connected with the Mission Hospital of Holy Cross Liberian Mission. The review reads that:

The author refers to the statement, which is made repeatedly in the literature, that cancer occurs in native races only when they have come into contact with civilization and have adopted European customs to which they are not adapted. He describes, with histological diagnoses, two cases of cancer in the Liberian branch of a tribe which "has up till now had practically no contact with European civilization." (1) Adenocarcinoma of mamma with involvement of axillary glands in a woman of 40 to 45; (2) ulcerating cornified epithelioma below knee in a man of 40 to 45; recurrence in inguinal glands after excision and death from cachexia.

To the foregoing observations and statistics I am able to add some recent data for the Union of South Africa. During the year 1927, the number of deaths from cancer reported for the non-European population of the nine principal cities was as follows: The number of deaths of males from all causes was 7288, of which 101, or 1.3 per cent, were attributed to cancer. Out of 4676 deaths of females, 78, or 1.6 per cent, were from

cancer. Unfortunately I cannot correlate these figures precisely to the population affected, but for Cape Town I have some additional data. The number of deaths from cancer during the fiscal year 1926-27 was 176, of which 114 were of Europeans, and 62 of non-Europeans. Worked out on the basis of the population, this is equivalent to a rate of 102 per 100,000 for the Europeans and 63 per 100,000 for the non-Europeans. As observed in the Official report on the health of Cape Town by Dr. T. Shadick Higgins, "From the foregoing figures it will be observed that the recorded rate of mortality from this disease amongst Europeans was greater by over one half than amongst non-Europeans. In both races the usual preponderance of mortality amongst females is not seen in this year's figures." While the non-European population includes a small proportion of Asiatics this, in Cape Town at least, is not significant. The report gives the rate for 1916-26 for non-Europeans as having been 53 per 100,000, which by 1926-27 had increased to 63. The 61 deaths among non-Europeans during 1926-27 were distributed as follows: Two of the deaths were of the buccal cavity; 34 of the stomach and liver; 6 of the peritoneum, intestines and rectum; 7 of the female generative organs; 4 of the breast; 1 of the skin, and 7 of other organs and parts.

I have returns also for Southern Rhodesia for which during 1926, 12 deaths from cancer were reported for non-Europeans, of which 5 were of the stomach and liver; 2 of the peritoneum, intestines and rectum; 1 of the female generative organs; and 4 of other organs or parts. During 1927 there were 17 deaths, of which 11 were due to cancer of the stomach and liver; 1 cancer of the female generative organs and 5 of other organs or parts. In Rhodesian hospitals during 1926 the number of admissions for malignant tumors was 24 with 14 deaths, while there were 10 admissions for non-malignant tumors with no deaths. During 1927, there were 29 admissions for malignant tumors with 17 deaths and 18 admissions for non-malignant tumors with one death. Unfortunately again, I cannot give

the corresponding population with sufficient accuracy to justify the calculation of rates.

In addition to the foregoing I have carefully examined the reports on health and sanitary conditions of Northern Rhodesia for 1927 and 1928. These reports are almost entirely hospital reports and contain occasional mention of cancer cases of which I will cite the following illustrations for the year 1928. At the Livingston Hospital, out of 1386 admissions, one was attributed to cancer and 2 to non-malignant tumors. At the Lusaka Hospital out of 501 admissions, none was attributed to cancer. At the Broken Hill Hospital, out of 1622 admissions, 4 were from cancer or malignant tumors but the type is not indicated. At the Mongu Hospital, out of 557 admissions none was from cancer but there was one admission for non-malignant tumor. At the Kasama Hospital, out of 341 admissions, none was from cancer or non-malignant tumors. At the Fort Rosebery Hospital, out of 338 admissions, one was from cancer. At the Choma Hospital, out of 548 admissions, none was attributed to cancer. At the Abercorn Hospital, out of 102 admissions, 2 were for non-malignant tumor. At the Ndolo Hospital, out of 435 admissions, none was attributed to cancer or non-malignant tumors, and the same is true at the Mazabuka Hospital, where there were 866 admissions with not a single case of malignant or non-malignant tumor. At the Solwezi Hospital, out of 1041 admissions, one was from cancer. At the Fort Jameson Hospital, out of 474 admissions, 2 were for non-malignant tumors. Summarizing these results, it appears there were 8211 admissions, of which only 8 were attributed to malignant tumors and 6 to non-malignant tumors. Since all these hospitals are under European administration in which all the physicians are assumed to be competent for diagnostic purposes, the evidence is therefore quite conclusive that malignant and non-malignant tumors in South Africa among the native population are relatively still rather rare.

I will not further enlarge upon the contents of the African reports although there is much more material that could have been included, but I may add that for the Colony of Gambia, for example, I have examined five years of reports of the local health service revealing extremely few cases of malignant tumors admitted to the local hospitals under European administration.

I cannot, however, omit from the foregoing discussion a reference to an extremely interesting contribution on "Cancer and Race in British Guiana" by Dr. J. F. C. Haslam of the Government Public Health Department, British Guiana. He points out by way of introduction that the population of British Guiana consists in round numbers of 120,000 Blacks of African origin and 120,000 East Indians together with a comparatively insignificant number of other nationalities. The Blacks and East Indians have lived side by side for many years under identical climatic conditions and the other circumstances of their existence present no wide divergencies between the two races. As to occupation, the East Indians are more exclusively agriculturalists than the Blacks, while the latter do most of such heavy labor as is done at all. As to diet, some of the East Indians do not eat meat, and a large number are restricted, as to the kind of meat eaten, by religious considerations; the Black eats anything which his purse can compass. The strictly vegetarian high caste Brahmin hardly exists in British Guiana and the tendency is for racial and religious prejudices as to diet to disappear. Rice figures prominently in the dietary of both races under consideration. No statistics of value for the present purpose are available for the years previous to 1891. Prior to 1910 the site of cancers was not stated and prior to 1920 it was only for the East Indians that deaths were placed in age groups. Hence the most useful statistics are for the years subsequent to 1920. The age and sex composition of the different races cannot be accurately arrived at but it is certain that in some years at least the two populations differed markedly in these re-

spects. Subject to the foregoing limitations and deficiencies, examination of records for thirty-three years shows that during this period, 1754 persons died of cancer, of whom 397 were East Indians and 1357 were others. This term includes the whole population of the Colony less East Indians, but the white population is very small. On this basis the cancer death rate for 1921-24 is estimated at 9 per 100,000 for East Indians and 17 for the Blacks and other mixed blood population. From year to year the rise and fall in the rate in the two races have corresponded remarkably. In other words, the East Indian rate has been consistently lower than the Black and other white and mixed blood population. Dr. Haslam raised the question whether it is possible to apply the foregoing information so that one may judge of the cancer mortality among Blacks. The Blacks, he points out, form the largest and a very constant constituent of the "Others" population, varying from 66 to 68 per cent of the total. Any racial features of the Blacks as to cancer mortality would therefore strongly and constantly influence the mortality rate for "Others." On the basis of such information as he was able to collect, he calculated the Black population for 1924 as 119,470, and the total of other populations as 176,237. Among these elements during 1924 there occurred only 52 deaths from cancer, equivalent to a rate of 29 per 100,000. He argues that supposing the rate for Blacks was the same as for the East Indians, then for the thirty-four years under review, the remainder of Europeans, Chinese, Portuguese and mixed, would require to have had a cancer mortality of 25 per 100,000, or nearly double that for the whole population. But even if the whole population's rate is applied to the Blacks, then the rate for the Europeans, etc., must still have been as high as 25 per 100,000, which is by no means incredible even granting that all the white populations are assigned a lower cancer death rate in temperate latitudes. Dr. Haslam, however, calculates, for the last five years under review, the specific death rate for Blacks and East Indians with the following

results. Whole population, 19 per 100,000; black population, 22 per 100,000; East Indians, 11 per 100,000. He gives the distribution by sites for the black population as follows; buccal cavity, 6; stomach and liver, 54; peritoneum, intestines and rectum, 1; female generative organs, 38; breast, 24; skin, 2; other organs or parts, 37, a total of 162. He also gives some statistics by ages for the black population as follows: deaths from cancer under twenty, only 2; ages twenty to thirty, 4; thirty to forty, 20; forty to fifty, 27; fifty to sixty, 46; sixty to seventy, 32; seventy to eighty, 19; over eighty, 12. These were not suggestive of anything very abnormal in the age distribution, except as is the case in all tropical countries, the proportion of persons over sixty is less than for the corresponding white population in temperate latitudes. Dr. Haslam calls attention to the much higher proportion of cancer of the breast among the Blacks than among the East Indians. He concludes his interesting observations with the following statement:

In view of the imperfections in statistical records it is impossible to consider the results of this enquiry as conclusive, but there appears to be a *prima facie* case for the opinion that there is a racial difference as to cancer mortality between the East Indians and Blacks in British Guiana. It may be possible to check the results obtained against the statistics of other places and the enquiry is being pursued.

I may seem to have drifted far afield in my discussion of the cancer mortality of the American Negro but I feel strongly that the question at issue cannot be fully understood without an international background in view of the alien origins of our negro population. Those who wish to pursue this study further cannot do better than read an interesting discussion entitled, "The Cradle of the World and Cancer, a Disease of Civilization," by Dr. Ernest H. Tipper of the West African Medical Service (retired), published in London in 1927. It has some extremely valuable observations on the negro in Africa and the extreme rarity of cancer in natives not in contact with civilization but pointing out evidence that the liability to the disease

increases almost invariably with the growth of town settlement and contact with the white population. Dr. Tipper is emphatically a believer in the dangers of a high protein or meat diet and he produces much evidence in support of his view that abstinence or moderation in meat eating often coincides with the rarity of malignant tumors. He gives a most interesting account of native foodstuffs which suggests the urgency of similar dietary studies of the negro population in this country. The only two really qualified dietary studies of negroes with which I am familiar have been made in this country and published in 1897 and 1899, respectively, on the negro population of Central Alabama and the negro population of Eastern Virginia. These two studies are suggestive of dietary variations particularly in the case of plantation negroes well deserving of serious consideration. I cannot enlarge upon this phase of the problem without unduly extending the scope of my remarks.

I would fail also if I did not point out in this connection that the whole discussion of the American negro cancer mortality is vitiated by the omission of the elements of race intermixture as the result of which we deal with a heterogeneous population of which only a relatively small proportion represents a strictly African type. For several hundred years the negroes of this country have been in contact with our civilization and are habituated more or less to our mode of living. The range of intermixture runs from almost near white to pure black including every possible alien strain of blood, producing an entirely new type of mankind immensely at variance with the negro population of Africa or for that matter for some parts of the West Indies. It should not be difficult, however, to carry on an extended research into the subject and single out survivals of the earlier African origin of our negro population, and ascertain the varying degree of susceptibility in the pure black, the near black, brown, yellow and near white types of the race. Without such discrimination all observations upon the cancer mortality of the negro population, considered as a homogeneous group, must be more or less fallacious and

approximate closely the corresponding results for the white population. Even so, however, there are still marked differences which become more and more apparent as we deal exclusively with the negroes in the black belt and particularly in such sections as the Sea Islands of South Carolina. I am strongly inclined to think that malignant tumors in the pure blacks will be found to be much less common than in those types which show a considerable degree of white intermixture. But this question for the time being cannot be answered.

Briefly summarizing the foregoing the following conclusions would seem to be justified by the evidence available.

1. The present cancer mortality of our American Negro population tends more and more to approach the corresponding cancer death rate of the white population.

2. The cancer death rate of the negro population has shown a persistent rise during the last thirty years and is now in marked contrast to the earlier death rates although more or less imperfectly recorded.

3. Fragmentary evidence available seems to justify the conclusion that malignant tumors in the slave population were extremely rare, corresponding in this respect to present day conditions in practically all parts of Africa.

4. The outstanding fact of the negro cancer mortality is the much greater liability of negro women to tumors of the generative organs, and in addition thereto a very much greater liability to non-malignant tumors of the same organs.

5. Among the most useful data on the differential mortality of the two races are found in the experience of the Metropolitan Life Insurance Company for the period 1911-1922. By organs and parts these show the following illustrative differences: Cancer of the buccal cavity for males shows a death rate of 4.5 for the whites and 2.3 for the negroes. This difference is sustained by a wealth of other data indicating the decidedly lower liability to cancer of the buccal cavity on the part of the male colored population. Cancer of the stomach and liver, however, for males shows a death rate of 23.9 for the whites and

17.4 for the negroes. For females the respective rates were 28 for the whites and 19 for the negroes, suggestive of the lesser liability on the part of the negro race for both sexes. This difference unquestionably is partly at least attributable to variations in dietary habits which are deserving of extended study. Cancer of the female generative organs shows a death rate of 24.9 for white women and 38.4 for colored women. The much greater liability of negro women to cancer of the uterus, ovaries, etc., is sustained by a wealth of other data for both this country, the West Indies and Africa. Cancer of the male breast shows a rate of 0.1 for the whites and 0.2 for the negroes. This conclusion is also supported by other data suggestive of certainly double the liability of negro males to cancer of the breast, which however is an extremely rare affection. Cancer of the female breast shows a rate of 11.7 for the whites and 14.6 for the negroes. This higher liability to cancer of the breast is rather in contrast to general conceptions as to the relation of cancer of the breast to habits of breast feeding. As far as I know, negro women much more generally nurse their babies, even to their second year, while the practice of bottle feeding is apparently much more common among white women. Other causative factors, therefore, must enter into the greater liability of negro women to cancer of the breast than breast-feeding habits. Negro women also wear much less obstructive clothing than white women and yet they suffer more from cancer of the breast, which is very often attributed to the wearing of corsets or tight lacing.

6. Cancer of the skin prevailed at the rate of 2.1 for the white males and 0.7 for colored males. For females the rate was 1.6 for the whites and 0.8 for the negroes. This conclusion is also supported by much other evidence suggestive of the protective value of skin pigmentation. Of special importance on this phase of the problem are the observations on Melanosis by Dr. W. G. Spencer in his Bradshaw Lecture in 1923,¹ illustrating the importance of pigmentation in the etiology of new

¹ Reviewed in the *Brit. M. J.*

growths. All the authorities that I have consulted on the subject seem to hold to the opinion that the colored races are less liable to skin cancers on this account and certainly this view seems to be supported by the available statistics. Paul, in his treatise on "The Influence of Sunlight in the Production of Cancer of the Skin"¹ observes that:

The pigment of the skin stands as a sentinel, guarding the underlying tissues from the baneful effects of sunlight. In the white races this pigment is confined for the most part to the periphery of the cells of the basal layer of the epidermis and to the lowermost stratum of the prickel-cell layer, whilst the pigment granules may also be found in the interepithelial lymphatic spaces, and in the fusiform connective tissue cells of the papillary body. In the dark races, Macleod states that pigment is to be found as high up as the transitional layers of the epidermis, as well as in some of the connective tissue cells of the superficial portions of the corium. But the white races have the power of reacting to the external stimulus of light with an increase in the amount of pigmentation. The common occurrence of these cancerous and precancerous diseases of the skin in Australia is to be regarded as normally destined to be occupied by a coloured race.

The subject of the occurrence of skin cancers in Australia has been exhaustively studied by Dr. Herman Lawrence who has made a number of valuable contributions to this phase of the problem but it would carry me too far to enlarge upon it. In any event cancer of the skin constituted only 1.4 per cent of the negro deaths from cancer in the United States during 1923-27. In the total American population in 1927, this proportion was 2.8 per cent. Thus there is a marked difference, in favor of the negro, in cancer of the skin, deserving of consideration.

7. As regards diagnosis, it goes without saying that in many cases the whites in this respect have a great advantage on account of earlier and better treatment. But this conclusion hardly applies to the major portion of the colored population living in our large cities. The negro shows no aversion to making use of hospital facilities and in some instances is probably more ready to go to institutions than a white person. The statistics in this respect for New Orleans are quite convincing.

¹Lond., 1918.

In the matter of autopsies, however, there is a lesser chance of a correct final diagnosis in the case of the negro which probably somewhat impairs the value of the general statistics.

With these observations I conclude an inquiry into a most important phase of the general cancer question. I cannot too strongly emphasize my convictions that a thorough study of cancer in the American Negro and collateral studies of cancer in the negroes of the West Indies and Africa would lead to very important conclusions. It is to the credit of Dr. Matas that he should have been among the first to emphasize the racial differences, and I consider it a great privilege to be permitted to contribute to this interesting symposium of his outstanding work as a physician, surgeon and benefactor of mankind.

CANCER OF THE STOMACH

WITH SPECIAL REFERENCE TO ITS INCIDENCE, DIAGNOSIS AND
TREATMENT

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INCIDENCE

THE last census reports available for the estimation of the mortality from cancer in the United States show that in the year 1927 there were 103,578 deaths from cancer in the Registration Area of the United States. Of these, 36,879 were from cancer of the stomach and liver. As primary cancer of the liver is very rare, and as deaths are listed according to the original site of the cancer, it seems probable that at least 35,000 are from cancer that originated in the stomach.

In Virginia there were during 1929, 1686 deaths from cancer as against 1567 in 1927, with 560 deaths from cancer of the liver and stomach in 1929 and 516 in 1927, probably more than 90 per cent of this combination being from cancer of the stomach.¹

Deaths when sudden and spectacular attract much attention, as from the explosion of an airship, a railway collision, an automobile accident or the sinking of a ship. But the fact that more than 100,000 persons perish quietly in the United States every year from cancer (one-third of them from cancer of the stomach) causes but little comment. Cancer of the stomach is responsible for far more deaths than cancer of any other single organ. When we consider that malignant tumors from all other regions, such as the colon, rectum, pancreas, kidneys, bladder, prostate, breast, ovaries, uterus, mouth, neck, brain, skin, muscle and bone make up the balance which is scarcely two-thirds of the total mortality from cancer, we can readily see how seriously cancer of the stomach should be considered.

CAUSES OF DEATH FROM GASTRIC CANCER

In a recent article by Saltzstein and Sandweiss² of Detroit, there is an analysis of 365 consecutive deaths from cancer of the stomach collected from the Cancer Division of the Department of Health of Detroit. It includes all the deaths registered as due to cancer of the stomach from a population of 1,730,000 during one and a half years. Of this number, only 28, or 7.7 per cent, had resections of the stomach for cancer, and of these only 11, or about 3 per cent, recovered from the operation. It is obvious that many of this small group operated upon came late and were desperate risks.

Margaret Warwick,³ in a report of 176 necropsies on cancer of the stomach from the Department of Pathology of the University of Minnesota, extending over a period of twenty years, shows that the deaths from cancer of the stomach occupy a total of about 30 per cent of all the Department's necropsies on cancer. Her report brings out many interesting facts. The age varied from thirty-two to eighty-two years, but the average age was fifty-nine years. The largest number of deaths in any decade (35 per cent) occurred in the sixth decade, and the next largest number (29 per cent) in the fifth decade. Cancer of the stomach was found much more frequently in men than in women, and was often located in the pylorus (42.2 per cent). It is interesting to know, too, that in only 43.4 per cent of the cases of this series was ulceration present, and of this number 51 per cent showed perforation and in about one-third of these the perforation was plugged. In two-thirds of the cases with perforation death from peritonitis occurred. The most frequent fatal complication was peritonitis. There was no emaciation in about 18 per cent of the cases. In 23 per cent, or 40 of the fatal cases, there was no metastasis, the growth at the time of death being confined entirely to the stomach. In many of these cases the death was due to peritonitis.

This brings up the subject from a new angle. The fact that of this series of 176 deaths from gastric cancer 23 per cent 40

of the cases had no metastasis, the growth being confined to the stomach at the time of death, and yet in the larger series of Saltzstein and Sandweiss (365 cases) resection was done on only 7.7 per cent (28 cases), shows that many opportunities for cure must have been missed. In some of the 23 per cent the cancer was probably located in the inaccessible cardiac regions, but it is more common at the accessible pylorus than elsewhere.

Cancer of the stomach presents variable forms. We are often accustomed to think of it as an ulcerating necrotic mass and yet the statistics of Warwick show that in only 43.4 per cent of these necropsies was ulceration present.

ETIOLOGY

The cause of cancer is a subject which the limit of space will not permit us to discuss except to say that the theory that seems more probable now than any other is that cancer is not due to a parasite or any microorganism, but that it springs from a derangement of one or more local cells in the tissues. This derangement results in a freeing of the cells from the normal control of the surrounding tissues, which abolishes the restraint of going through the normal biologic processes of growth. These cells after acquiring this attribute of unrestrained growth can transmit it to their own offspring. The fact that cancer in mice can be produced in the laboratory by frequent painting of the mice with tar, and that the resulting cancer will metastasize and can be transplanted, shows that some irritant is primarily responsible for the neoplasm. It may be, of course, that some microorganisms act indirectly by causing irritation, but that cancer is primarily due to bacteria or a microscopic parasite in the same sense that typhoid or tuberculosis is, is hardly tenable.

Certain tissues of the body are less liable to cancer than others. The cause of this comparative immunity is not known, but very obviously exists. It may be due to the natural stability of the tissue. I have never seen a primary cancer of the palms of the hands or the soles of the feet, yet cancer of the mouth,

tongue and lips is common. Cancer of the stomach is also common, and as has been stated, is one of the greatest causes of mortality from cancer, and yet cancer of the duodenum is extremely rare, almost a surgical curiosity. It is necessary, then, to have some cause besides irritation.

So far as we know, from observable regions of the body, cancer never springs directly from normal tissue. If this holds in the face, tongue, rectum or uterus that can be observed, it seems highly probable that the same general rule should obtain in the stomach which is difficult of direct inspection. It would be an anomaly if the irritation in the stomach caused by peptic ulcer did not occasionally at least produce cancer, whereas irritations of the mouth and lip of people of the same age are known to be one of the chief causes of cancer. Ulcer of the stomach is much less frequent than ulcer of the duodenum, in the ratio of probably about 1 to 4, but the duodenum, like the palms of the hands, seems almost immune to cancer. In fact, the number of cases of peptic ulcer of the stomach corresponds in a general way to the number of cases of cancer of the stomach. Much stress has been laid upon the size of the ulcer of the stomach, the large ulcers being more likely to be cancerous than the smaller ones. My own experience, however, shows that while this in a general way is true, there are many exceptions to it. I have had several cases of large ulcers of the stomach 5 or more centimeters in diameter that were benign, and one case at least of a small ulcer of the stomach, not more than 1.5 cm. in diameter, that proved to be malignant. No set rule can be made for this, but the marked tendency is for the larger gastric ulcers to be cancerous.

SYMPTOMS

The symptoms of cancer of the stomach are not typical. The most important thing to bear in mind is that there is no typical history or symptom of cancer of the stomach. It is more frequent in men. In Saltzstein and Sandweiss' analysis of 365 cases it was found that about one-fourth of all the

cases gave a history of prolonged attacks of stomach trouble, and about one-third of this number gave a fairly typical clinical history of peptic ulcer. It must be recalled, however, that gastric peptic ulcer is not infrequently found without a so-called typical history. The large gastric ulcers may cause more or less discomfort with no connection with food relief, and sometimes the first symptom is hemorrhage. Hemorrhage is a rather infrequent symptom in cancer of the stomach, probably less than 2 per cent (1.4 per cent in Saltzstein and Sandweiss' cases). When it is considered that, according to Warwick, only 43 per cent of cancers of the stomach showed ulceration, we can see that hemorrhage is by no means as common in cancer of the stomach as is usually supposed.

The examination of the gastric contents in cancer of the stomach usually shows a low hydrochloric acid content or, not infrequently, a complete absence of hydrochloric acid. This, however, is by no means a universal finding, as early gastric cancer may occur with normal hydrochloric acid in the gastric juice. Blood and lactic acid in the gastric juice may be suggestive, but should not be depended upon too much.

In about three-fourths of the cases there are no preliminary symptoms, but the cancer arises in otherwise apparently healthy individuals and goes on steadily toward death. There are, however, many cases of antecedent long-drawn-out histories of stomach trouble extending over periods of years. In one of my patients whom I operated upon at the age of seventy years, there had been intermittent stomach trouble with some food relief for forty years, and at operation there was cancer of the pylorus, not very advanced, but producing partial obstruction.

In the three-fourths of the cases of gastric cancer in which there are no such preliminary symptoms, the situation is more serious because by the time symptoms from the cancer have arisen the growth may be well advanced. In many of these instances the cancer is in the so-called silent areas of the stom-

ach. Physiologists have shown that the lesser curvature contains tissue acting somewhat like the neuromuscular tissue of the heart, and initiating peristalsis; an ulcer or lesion in this region usually produces symptoms because of the spasm and interference with the motor function of the stomach. Of course, at the pylorus obstruction occurs early. In many cancers of the stomach (about 42 per cent according to Warwick) the tumor is at the pylorus and will cause early symptoms of obstruction. Because three-fourths of gastric cancers arise in apparently healthy persons without preliminary symptoms and march on to inevitable death unless the cancer is removed, it does not mean that there was not a preliminary lesion. As has been mentioned before, cancer elsewhere in the body always starts from abnormal tissue, and it is reasonable to expect this to be true in the stomach. Necropsies and roentgenologic examinations not infrequently show ulcers of the stomach or healed ulcers that have given no symptoms. Lesions along the greater curvature or in the cardiac portion of the stomach may exist without causing any symptoms unless perforation or hemorrhage occurs, or unless the growth is so large as to produce obstruction. In a case of my own (Mrs. S.), a cancer of the colon was removed which had given symptoms only for a few months, though the growth must have been present much longer, and there were several benign adenomas in the region of the cancer. It seems highly probable, then, that some lesion such as a symptomless adenoma or ulcer has been the preceding cause of the cancer of the stomach that arises without preliminary symptoms. It is well known that in the colon and rectum benign adenomas and papillomas that have existed for years often degenerate into cancer.

Miller, Eliason and Wright⁴ have recently reported eight cases of their own in which carcinomatous degeneration of a polyp of the stomach occurred. They think this condition is much more frequent than is usually believed, and have found it in 35 per cent of all gastric polyps they have fully studied. These polyps were adenomas or papillary adenomas, and were

usually found in men. The chief symptoms were hemorrhage and intermittent obstruction. In some of their cases the hemorrhage was slight but frequent, and caused profound anemia resembling pernicious anemia.

According to Saltzstein and Sandweiss, of 213 patients who died of cancer of the stomach when the onset was from previous good health, in 74 the first symptom was "indigestion," pain in the epigastrium in 21, a history of ulcer in 20, vomiting in 15, gastric hemorrhage in 3, difficulty in swallowing in 5, gnawing sensation in the epigastrium in 3, distended abdomen in 3, and fullness in the stomach in 3. Of the atypical symptoms there was loss of weight and weakness in 37, loss of appetite in 14, atypical pain (not in upper part of abdomen) in 11, anemia in 2 and diarrhea in 2. It is readily seen, then, that there is no typical symptom for cancer of the stomach, either when it results from the changing of a gastric ulcer into cancer or when it arises in individuals who are otherwise apparently healthy. It is significant to note, however, that in a long history of stomach complaint when the symptoms change and become constant instead of intermittent, or when the appetite begins to disappear and the patient loses weight, or when vomiting of blood occurs, there often seems to be a transition from a benign condition into malignancy. I am trying to avoid the use of emaciation, palpable tumor, vomiting blood and cachexia as symptoms of gastric cancer, because these are often the terminal stages and too frequently the patient with these symptoms may have gone beyond hope. Even in such patients, however, there may occasionally be some chance for cure or at least palliation by operation. If we recall the fact that, according to Warwick, in 40, or 23 per cent of, necropsies for cancer of the stomach the cancer was limited to the stomach itself, it appears possible to have a palpable tumor, hemorrhage and some cachexia while the cancer is still confined to the stomach. This, of course, does not mean that we should wait for terminal symptoms, but it does mean that there are some apparently advanced cases

that may occasionally be saved. Palpable lymph nodes in the lower portion of the neck, especially on the left side, referred to as Virchow's glands, in the presence of cancer of the stomach indicate that there are metastases through the chest and in the supraclavicular region. Such cases, of course, are obviously inoperable from any standpoint of cure, and this may be one of the terminal symptoms. When the cancer of the stomach is of very great malignancy, metastases may occur in the lymph nodes of the neck before the lesion in the stomach has progressed very far.

The most dependable means of diagnosis of cancer of the stomach is a roentgenologic examination by a competent roentgenologist. Nothing requires more care and responsibility than the examination of the stomach by x-ray. While pictures of fractures can be easily taken, a competent roentgenologic examination of the gastrointestinal tract requires great skill. I have not infrequently had x-ray plates referred to me with a diagnosis of cancer of the stomach when the defect was due to the pressure of the spine upon the plates while the patient was lying prone. One who does much gastric surgery will be able to recognize this type of x-ray plates rather easily and save the patient an unnecessary operation. Fluoroscopic examination is as important as the plates, and should be interpreted by a competent roentgenologist. In the hands of a well-trained roentgenologist, a diagnosis of cancer of the stomach can be made rather positively in about 90 per cent of the cases; on account of the location of the lesion and for other reasons in about 10 per cent the diagnosis cannot be made even by the best roentgenologist.

The chief thing that I wish to impress is that if a patient, particularly a man, begins having symptoms of so-called indigestion or stomach trouble, after thirty-five years of age, and it cannot be cleared up by ordinary simple remedies and regulation of diet in two or three weeks, the patient should be referred to a competent roentgenologist for a thorough examination of the gastrointestinal tract. If an ulcer of the

duodenum is found and is in an early stage, it should be treated medically for at least several months, or even longer if there is no complication. Many peptic ulcers of the duodenum can be cured by careful medical treatment. It is only when they resist medical treatment and recur, or when there is perforation, hemorrhage or obstruction, that operation is indicated. In the persistent types, however, or when the ulcer is very large, operation is the best treatment.

In an ulcer of the stomach the problem is different. Ulcers of the stomach are more difficult to cure by medical treatment and, in addition to that, the tendency for ulcers of the stomach to degenerate into cancer, which occurs to almost no extent in ulcers of the duodenum, is a very serious factor. If the ulcer of the stomach has been giving symptoms for only a few weeks, and can be treated satisfactorily and appears to be healing after six to eight weeks, the medical treatment may be continued longer, but if it is not healing it should be operated upon. W. J. M. Scott⁵ has called attention to the fact that even x-ray examinations at intervals of a few weeks do not always show the actual facts, because sometimes the infiltration of a small lesion may fill out a niche, when as a matter of fact the cancer is still progressing. He has reported cases with gastric symptoms five to ten years and negative x-ray findings for cancer, and yet with cancer shown at operation.

TREATMENT

There is only one treatment for cancer of the stomach, and that is excision. The sooner it is done the better. With modern technique and careful preparation, and with the choice of anesthetics, frequently either spinal or local, the mortality can be greatly diminished. The employment of the continuous intravenous injection of dextrose in Ringer's solution is very helpful, both as a temporary measure during the operation to prevent shock and following the operation to rest the stomach.

Gastroenterostomy in gastric cancer is rarely justified. A carefully done partial gastrectomy will carry almost as low

a mortality. If the cancer is so extensive that it cannot be resected, usually gastroenterostomy is contraindicated. There may be, however, occasional instances in which this operation is indicated. Saltzstein and Sandweiss state that: "It is being appreciated lately that gastric resection, if at all feasible, is a better palliative procedure than gastroenterostomy; patients are more comfortable following it, and patients with nodules in the liver have lived three years after gastrectomy for cancer."

For the past seven years I have been using a technique which is a modification of the Billroth I partial gastrectomy.⁶ This consists in uniting the lesser curvature of the stomach to the upper border of the duodenum, flaring open the anterior wall of the duodenum to prevent obstruction, which was a great objection to the original Billroth I, and folding in the redundant portion of the stomach along the greater curvature. In this way the so-called "deadly triangle" of Billroth is avoided. Occasionally, if the stomach is small, the duodenum may be flared open enough to make an end-to-end anastomosis.

When the cancer is too extensive for partial gastrectomy, a total gastrectomy may sometimes be done. In the case of Mrs. L. J., this operation was performed and the jejunum was united to the esophagus. Unfortunately in lifting up the stomach much of its contents regurgitated into the esophagus and when the clamp was removed from the esophagus after detaching the stomach the upper portion of the abdominal cavity was contaminated by the reflux from the esophagus. Though the peritoneum had been packed off with gauze, infection resulted and the patient died five days after operation. Examination of the stomach showed the cancer almost throughout the stomach, though necropsy did not reveal evidences of malignancy elsewhere.

In one patient, Mrs. B. H. H., a palpable tumor in the upper abdomen had been noticed by her for more than a year before she would submit to operation. A partial gastrectomy done according to the technique described resulted in immediate recovery. The patient lived in comfort for nearly three

years, and died of metastases in the chest and axilla with apparently no recurrence in the stomach. This shows that cases with palpable tumors are not necessarily inoperable.

In 1928 I published an article⁷ on gastric cancer in the aged, reporting 5 patients over seventy years of age on whom this partial gastrectomy was done. In 2 of them part of the colon had to be resected. The operative mortality was one, the patient dying as a result of resection of the colon. The oldest patient was seventy-seven years of age, and died nine months after operation of nephritis. No necropsy was held, but there was no evidence of recurrence of the cancer. The other patients lived comfortably from six months to two years, developing metastases usually in the liver. In spite of the fact that all of these cases were far advanced, two of them necessitating resection of the colon, and all of the patients over seventy years of age, the results in prolonging life and establishing comfort may be considered as not unsatisfactory.

I have had one patient, Mrs. L. E. H., seventy years of age, who had had symptoms for fifteen years. The symptoms were increased before entering the hospital. A partial gastrectomy was done and a rather small ulcer was found along the lesser curvature of the stomach. It seemed to have been irritated and caused marked spasm. On microscopic examination of the lesion one area was found in which there were two definite acini of cancer. This patient has been in excellent health since operation nearly two years ago (December 10, 1928) and will probably make a permanent cure. It is in patients such as this in whom the malignant lesion is found in the early stages that the best results are obtained.

SUMMARY AND CONCLUSION

Saltzstein and Sandweiss have shown that in Detroit, with its abundant hospitals, only 7.7 per cent of patients with gastric cancer have a partial gastrectomy. It seems probable that the percentage is even lower in Virginia. As partial gastrectomy is the only known cure for cancer of the stomach,

this means that only about one patient in twelve with cancer of the stomach is given any chance for a cure. Partial gastrectomy in early gastric cancer should give cures comparable to those after the radical operation for cancer of the breast, and even in the more advanced cases it often brings relief and prolongation of life. While it is necessary to study the early stages of any unusual gastric disorder in patients, particularly men, over thirty-five years of age, it is also well to remember that about one-fourth of the cases of gastric cancer are subsequent to some other gastric lesion giving symptoms for a long time (usually ulcer), and practically all of these cases should be recognized and operated upon in the early stages. In the other 75 per cent of cases, prompt attention to the first symptoms and a partial gastrectomy as soon as the diagnosis of gastric cancer is made will often result in the prolongation of life and sometimes in cure, whereas otherwise there is no hope.

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CANCER OF THE BREAST

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PHILADELPHIA

IN THE hall of the University of Pennsylvania Medical School there hangs a celebrated painting, entitled: A Clinic of Dr. D. Hayes Agnew. Professor Agnew is depicted, after having removed a breast from a woman, as standing to one side and commenting, one can imagine, on diseases of the breast in general, and malignant diseases in particular, naturally also on the type of operation he has just performed, its advantages and general prognosis. This painting bears the date 1889.

I am proud to say that it was my great privilege to sit at Agnew's feet in my student days and to pass several years as one of his assistants in the Surgical Service of the University of Pennsylvania Medical School and Hospital. Agnew was a man of international fame as a skilful surgeon and a tremendous force in molding the practice of surgery in all parts of the United States from which his students came and to which they returned imbued with his teaching, fired with ambition by his brilliant surgery, and inspired by his charming and lovable personality.

The operation for carcinoma of the breast as performed by Agnew (at the time the portrait was painted) consisted of simple breast amputation and routine dissection of the axilla, whether or not the axillary glands were enlarged. This enucleation he did with the fingers after extending the incision from the lower angle of the wound into the axilla. In amputating the breast Agnew was careful to include all of the skin covering that showed the slightest suspicion of disease, without regard to the size of the wound. When conditions permitted, his routine procedure consisted of two elliptical incisions, an upper and a lower one, parallel with the course of the fibers

of the pectoralis major muscle. Beginning with the lower incision, the skin was dissected downward far enough to allow sufficient adipose tissue to remain to cover the gland; the upper incision was then made in a similar manner. Where the cellulo-adipose tissue was abundant, he used the finger partially to separate the tumor from the overlying tissues. The mamma was then torn from the pectoral muscle by making strong traction on the breast, any adhesions that were encountered being separated with the knife. If the tumor had become adherent to the pectoralis muscle, Agnew tore it away by forcibly pulling on the breast rather than cutting with the knife, as by the former plan the diseased structures were more likely to be removed. When infiltration had extended to the base of the gland, even though there were no adhesions to the pectoral fascia, he dissected the latter carefully away from the muscle along with the breast. The vessels as they appeared were grasped with hemostatic forceps, but were not tied until after the breast had been removed. It is not necessary to describe his manner of closing the wound, although it is interesting to note that he made free use of antiseptic solutions at that time, with the remark that "only two weeks will be required for the healing of the wound uncomplicated by surgical fever or pus, a striking contrast to the results of the old manner of treatment, in which ordinarily from four to six weeks were spent in almost daily renewal of dressings and the pressing out of purulent matter."

This operation, considered quite a radical procedure at that time, was based on the practices of Charles Moore of Edinburgh who suggested it as early as 1867, in a paper entitled: "The Influence of Inadequate Operations upon the Theory of Cancer." Moore, in fact, recommended also the removal of the pectoralis major muscle and the lymphatic glands. In the evolution of surgery of the breast, the younger Gross (S. W.) of Philadelphia was among the first American surgeons to recognize the wisdom of this procedure and to advocate its adoption in practice as a possible means of curing

cancer of the breast, if, as he puts it, "it is attacked before it has disseminated itself extensively locally or has tainted the general system." Gross emphasized the primarily local character of mammary cancer, its tendency to advance toward the surface before it invades the deeper structures, the lymphatics and the viscera, and with refreshing confidence stated that local infection does not ensue, on an average, before the expiration of thirteen months, skin involvement in fourteen months, lymphatic glands in fifteen months, the walls of the chest in twenty-two months and the viscera in thirty-one months. Gross, being satisfied with three years after the last operation without recurrence as constituting a cure, claimed 10.5 per cent of cures, that is 51 out of 485 cases of ordinary scirrhus, medullary, colloid, or atrophying carcinoma, the average postoperative period being four years and ten months. We today are not quite so definite as to the time of involvement of the various parts, nor are we satisfied with a three year period of freedom of recurrence as constituting a cure, as will be seen later on.

The evolution of the modern radical operation for cancer of the breast has kept pace with the evolution and clearer understanding of the process of local dissemination of cancer cells. Moore was probably the first to enunciate the principles of metastasis and their practical application to the surgical treatment of carcinoma of the breast. He pointed out that after operation the disease spreads in the skin, the paramammary fat, the remaining portions of the mamma and the axillary glands. Accordingly, he advocated removing the entire breast and its covering, searching for outlying nodules that may be disseminated throughout the mammary region, dissecting off the fascia of the pectoralis major muscle and thorough exploration of the axilla.

It took some time for Moore's suggestion to make an impression upon the surgical world. Lord Lister in the early sixties is said to have pointed out the possibility and advisability of removing the axillary fat and its contained glands, and

in most cases also stripping off of the pectoral fascia. In America Gross, as we have seen, was the first to fall in line with Moore's views, and as late as 1880 felt obliged to defend his "boldness" in recommending that the axilla be attacked even when it seemed apparently free from disease. The prevalent theory in Moore's day was that malignancy is a systemic process. This theory was so deep rooted in the minds of the surgeons of that day that one must admire Moore for his bold stand and honor Gross and other surgeons who fearlessly followed in his footsteps.

The quarter of a century that followed Moore's contribution to the question of the operative treatment of cancer of the breast was characterized by active research into the pathogenesis of tumors and of cancer dissemination. It soon became apparent that the process of dissemination is a very complicated one. Even today, although we know that embolic invasion of adjacent lymph nodes occurs regularly, the problem of the further progress of metastatic cells still awaits solution. Dissemination, no doubt, begins early in the disease. Even the earliest clinical cases, that is, those that are seen within a few weeks or a month or two after a tiny lump in the breast is first noted, often present axillary involvement, occasionally detected clinically, but more often first found in the microscopic examination. Of course, we have no way of knowing in these cases how long the disease may have been latent before it became manifest in the shape of a tiny lump. In spite of various theories as to the time in which metastasis develops, that is to say, a theory that is applicable to all cases, experience has taught us that the premetastatic interval varies in different individuals, and that it is not very unusual, for example, for visceral involvement to be present without any palpable lymph nodes in the axilla.

Unsatisfactory as is our knowledge of the time relation of the primary growth and metastatic spread, we are on somewhat firmer ground as to the avenue by which dissemination travels. This we owe to the brilliant investigations and studies

of William Sampson Handley, with the resulting theory of centrifugal lymphatic permeation. This theory is the most rational explanation we yet have for the regional dissemination of cancer, as well as for a large percentage of local postoperative recurrences. It also forms a rational basis for the radical operation for cancer of the breast as it is generally practiced today.

History, to some extent, repeats itself in that a theory formulated by an Englishman received its application at the hands of an American surgeon, William Halsted. It is true that the radical amputation of the breast to include excision of the pectoralis major muscles was first practiced by Volkmann (1875) but he did so only where the muscles were visibly affected by the disease and not as a routine measure based on a rational theory. In passing I may say that knowing as we do, that involvement of the pectoral muscles indicates an advanced stage of malignancy, Volkmann's results were very remarkable. He claimed that local recurrence took place in only 35 per cent of cases in which the muscles were removed and in 58 per cent there were either local or regional recurrences, while in early cases in which the muscles were allowed to remain, there were 60 per cent of recurrences. It would seem, therefore, in the light of our present knowledge, that his results were in large measure due to the greater ease of approach to involved fascial and lymphatic structures provided by the removal of the muscle *per se*.

As I have already said, while to Handley we are indebted for the basic theory for the radical operation, it is to Halsted we owe the practical application of this theory and the perfection of the operation. By a remarkable coincidence Willy Meyer, of New York, and Sir William Watson Cheyne, of Scotland, simultaneously devised a similar procedure quite independently of Halsted. Willy Meyer urged the removal of both pectoral muscles in order to insure a more complete axillary dissection.

Before this time the pathogenesis of regional recurrences was entirely misunderstood. Billroth, for example, applied

the term regional recurrence to a return of the disease as long as one and a half years subsequent to operation, thus creating the impression, now considered false, that the recurrent growth was a new process, dependent either upon cancer diathesis in general or a local predisposition in the scar, and as occurring absolutely independently of the original growth. The enormous percentage of local recurrences shown by statistics, principally from large German Clinics over a period of twenty-three years (1867-1890) before the practice of systematically cleaning out the axilla had come into use, convinced Halsted that much of the fault must be due to the incomplete removal of cancer-laden tissues. Many surgeons in America at this time were in despair because of the hopeless prognosis of the surgical treatment of breast cancer. In fact, Halsted quotes Agnew as having remarked, shortly before his death in 1892, "that he [Agnew] operates on breast cancer solely for the moral effect on the patient, that he believes the operation shortened rather than prolonged life." This rather pessimistic attitude was scarcely justified, however, in view not only of Agnew's results but of the general results compared with those of previous decades. Halsted, however, struck at the fundamental cause of this sad plight of both patient and surgeon. With regard to the procedure as practised by advanced surgeons of his day he pertinently asks: "Why should we shave the under surfaces of the cancer so narrowly of the pectoralis muscle when a part of it can be removed without danger and without subsequent disability, and if there are positive indications for its removal?" Therefore he advises that the "pectoralis major muscle entire, except its clavicular portion, should be excised in every case of cancer of the breast, because the operator is enabled thereby to remove in one piece all of the suspected tissues." This removal in one piece of the suspected tissues was intended to avoid inoculation which might result from division of these tissues, or by division of cancerous lymphatic vessels, and to make sure that no shreds or pieces of cancerous tissue are overlooked.

The principles of the block operation have now been extended to conform with the anatomy of other cancer involved organs. We now know that there exists a local predisposition to cancer, that while cancer cells easily transplant themselves in the area primarily involved, more remote autotransplantation is difficult, and cutting into a cancer nodule is as dangerous as opening an appendiceal abscess into the free peritoneal cavity. The prevalent operation today is based upon Halsted's original procedure with more or less effective technical changes. The most significant modification is that of beginning the dissection at the apex of the axilla rather than from below, as was done in the original operation. This is important mainly to avoid the traumatic dissemination of cancer cells along the lymphatic route, a study of the site of local recurrences having shown that they are more frequent in the vicinity of the lower angle of the scar when the dissection is begun above, and vice versa.

By this procedure, early advocated, among others, by Rodman of Philadelphia, the axilla is attacked before removing the breast and working toward the axilla avoids the danger of expressing cancer cells into adjacent or even remote tissues, and the breast is not handled or massaged until the axillary dissection is completed. This method also reduces hemorrhage since the vessels are ligated at their origin, the time of operation is shortened and shock is minimized. One feature of Halsted's operation which has been considerably modified is the removal of the supraclavicular glands as a routine procedure. This to most surgeons seemed too radical in cases where the glands were not palpably enlarged. Rodman, however, strongly advocated exploring the supraclavicular triangle in all cases where the tumor is a peripheral one located in the superolateral hemisphere, the most frequent site of breast tumors, basing his argument on the discovery by Poirier and Cunéo of a set of lymph vessels which drain in the upper half of the breast and passing over the clavicle empty into the supraclavicular lymph nodes.

My operative procedure likewise is based on Halsted's method, except that I practically never employ skin grafting and I remove both the sternal and the clavicular portions of the pectoralis major and the pectoralis minor muscles and with very few exceptions close the wound at once. In case of a large growth involving practically the entire breast and where, owing to the scarcity of fat in the superficial fascia, the surrounding skin is not freely movable, there may be some difficulty in closing the wound. This can be largely overcome by extensive dissection laterally and medially. It is my opinion that in the average operable case greater danger lurks in insufficient removal of the deep fascia than in the skin that is likely to be involved. Moreover, removing the deep fascia is in accord with Handley's theory of cancer dissemination and does not add to the gravity of the operation, while postoperative complications are less apt to occur than in cases where large areas of skin are removed. This method, however, is not applicable to all cases of cancer, nor in the presence of extensive ulceration, but with wide dissection of the skin, and with the flaps made extremely movable, the necessity of skin grafting rarely arises and necrosis of the flaps just as rarely occurs. When necessary I do not hesitate to leave the wound open and to allow it to heal by granulation. Usually the patients leave the hospital in two weeks, the average time being 16.8 days: 13.9 days in the uncomplicated, and 29.8 days in the complicated case. Primary operative deaths are exceedingly rare. Postoperative shock is sometimes delayed so that careful watching for some hours after operation is essential and in case of failure to respond to the usual diffusible stimulants, saline infusion is resorted to, but this also is rarely required. Consecutive hemorrhage may occur but is unusual in my experience. Where, however, there is evidence of active bleeding I do not hesitate at once to open the wound, in order to evacuate the clots, tie bleeding points and flush the wound with hot saline solution.

The immediate mortality is satisfactory, in fact, I dare say is beyond the dreams of even the most sanguine of the early

advocates of radical operation. How they would rejoice at a primary mortality of 2.0 per cent, the figures of the Lankenau Clinic for the last fifteen years (682 cases, 14 deaths). It thus can definitely be said that the radical operation for cancer of the breast is one of the safest major operations. Our satisfaction, however, is tempered by our inability to cure more of our patients, interpreting as cured those who are living and well ten or more years after operation. Most of the patients (45 per cent) die of recurrence or metastasis in one form or another from one month to three years after operation. Practically 50 per cent of all patients who survive the operation have edema of the arm with or without recurrence or metastasis. These facts and the following figures are gathered from a series of 189 individuals on the records of the Follow-up Service from its inauguration in October 1920 to January 1926, who have reported to the clinic in person or who have been traced through questionnaires or visits by the staff of the Follow-up Service. The actual number of breast cases treated during that period was 221, of whom 32 could not be traced.

Of the 189 patients 21 are living at the time of this study (January 1931). Of the 21, five (2.7 per cent) are living and in perfect health for ten years without ever having had the slightest sign of recurrence, edema of the arm or any other trouble; 12 are living and well without recurrence from five to eight years (more than five years, 5; more than six years, 2; more than seven years, 2; more than eight years, 3); the four remaining patients are living but have more or less extensive recurrences as follows: One developed a small mass in the axilla forty-two months after radical amputation. At her last visit, sixty-seven months after operation, the axillary nodule was reduced in size (under x-ray treatment). There was slight swelling of the arm but motion was good; one is living at 104 months after operation without local recurrence but has some enlargement of the liver; another is living at 113 months. The last-named went without signs of recurrence or edema for ninety-six months. She then developed a very tiny hard

nodule above the clavicle and edema of the arm. When last seen at 113 months the conditions were unchanged, but the patient appeared in excellent health and spirits; the fourth patient refused radical operation at her first admission. A tumor was removed from the left breast which biopsy proved to be malignant. The patient could not be persuaded to have the breast removed. She was free from recurrence for seven and one half years, having been under x-ray treatment from time to time. She is very uncooperative and it was difficult to get any definite information. She is living at 102 months, with the local condition unchanged, but reported that she was working daily as a general housemaid. A fifth case (one of the 13) likewise refused radical operation. The tumor, a papillary cyst adenoma, was removed. She did well for four years. At fifty months she developed a shotty tumor in the lower part of the scar which grossly was diagnosed fibro-adenoma. Again she refused operation and when last heard from, at 113 months, she was in excellent health and doing laundry work.

We thus can claim 8.9 per cent of five year cures and 2.7 per cent of ten year cures.

Among the many angles from which the subject of cancer of the breast is to be considered, the most important with regard to achieving better end-results, exclusive, of course, of the possible control of metastasis or recurrence, is the prevention of edema not due to carcinomatous invasion of the lymphatics. The latter, it appears to me, is a subject for investigation by our anatomists, especially the younger ones. A re-study of the lymphatics of the axillary region may perhaps yield some valuable discoveries concerning variations and anomalies in that region. Such a study may also reveal a method of anatomical grouping of individuals according to their particular arrangement of axillary lymphatics, so that it may become possible for the surgeon of the future to be in a position to decide what type of individual would have a tendency to develop edema, and thus perhaps be able to modify

the operation accordingly. This may sound chimerical but it is no more so than other ideas that have changed the entire aspect of medical and surgical thought.

I am fully aware that recurrence and metastatic extension of cancer are undergoing constant study, for therein consists a very important phase of cancer control. Early recognition and early treatment are the slogans of those concerned in this vital public health movement. Most of us are under the pleasant impression that the propaganda has been actually fruitful. A surprising result of the comprehensive study of this aspect of the subject made by Dr. Reimann, Director of the Lankenau Research Institute, is the fact that there is room for very great improvement in this respect. While on the whole patients are presenting themselves for treatment earlier, the change is insignificant. The average time of delay in all cases is still 5.6 months, and there has been no inflection in the curve to indicate that the educational campaign begun in 1914 has had any marked effect. In the three year period, 1923-27, we find that the patients came only about three and a half weeks earlier than they did in the period between 1900-1904, not enough to mark any material improvement. This means that the propaganda must continue unabated as one means of effective control of cancer. The evidence is discouraging, but it all the more emphasizes the necessity of continued unremitting perseverance in bringing the matter to the attention of the public. One often hears the remark made that publicity and propaganda are more harmful than otherwise, because of the alarm and terror they may arouse in an ignorant and unintelligent public. The argument is a specious one. The imaginary horror is not nearly so harmful as the actual terror that accompanies malignant disease.

Much is being said and written with regard to radiation in the treatment of cancer of the breast, both as a means of cure and as a preoperative or a postoperative adjunct to surgery. Much of the information on this subject, it seems to me, is obscured by the enthusiasm of its advocates and the

harsh criticism of its opponents. Personally, I may say that I am not enthusiastic one way or another. I have little opportunity of seeing any actual cures that have been obtained by radiation. While not by any means enthusiastic about post-operative radiation, I am prepared to say at present that herein lies its greatest field of usefulness. There is no doubt of its marked palliative effect in prolonging life and making it more bearable. In a number of instances it does dispel a threatening recurrence, but these are few and far between, at least in my experience.

ANESTHESIA

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NO DEPARTMENT of surgery has shown greater development than that of anesthesia; on the other hand, in perhaps no other department of medicine has there been greater diversity of opinion regarding methods. In general, however, the trend has been the same, that is, away from the harmful, deep inhalation anesthesia toward lighter, less harmful anesthesia, analgesia, and regional and spinal anesthesia.

The history of anesthesia has been so well written by various authors: Gwathmey,¹ Flagg,² Allen,³ and Braun,⁴ that it is not necessary to recapitulate any phase of its historical record, except to emphasize the fact that to whomever belongs the credit for the first practical use of inhalation anesthesia, whether it be Long or Morton for ether, Wells for nitrous oxide, or Simpson for chloroform, the fact remains that with the fourth decade of the nineteenth century began a new era in surgery, paralleled only by the aseptic era initiated by the work of Pasteur and Lister. Although, as already stated, I do not propose to write even a brief history of anesthesia, a few outstanding events should be mentioned in addition to those already referred to, namely, the introduction of cocaine by Koller in 1844, of novocaine by Braun in 1905, of the combination of oxygen and nitrous oxide by Andrews in 1868, the introduction by Alexander Wood in 1853, of the hypodermic syringe, which made possible the rapid advance of the use of local anesthesia, and the important work of Dr. Matas who advanced from the use of local anesthesia in minor surgery to its use in major surgery. Matas soon progressed into the field of regional anesthesia and proceeded so rapidly that in 1900 he published two truly epoch-making papers, one on "The

Growing Importance and Value of Local and Regional Anesthesia in Minor and Major Surgery,"⁵ the other on "Local and Regional Anesthesia with Cocaine and other Analgesic Drugs."⁶ By 1900 he was able to show that from 50 to 60 per cent of the operations which six years before would have required a general anesthesia could be performed under local or regional anesthesia.

During the period of Dr. Matas's investigations, I had begun researches to discover, if possible, the cause of surgical shock, and had discovered that the phenomena of shock do not follow injuries in territories the nerve supply of which is blocked either by local anesthesia or by a spinal block. My collaborators and I found also that shock is lessened by the administration of morphine, and that it is diminished also by careful handling, sharp dissection and minimum trauma. These investigations, published in 1899,⁷ 1901,⁸ and 1903,⁹ laid the foundation for the combination of anesthetic and surgical methods which we later designated *anoci association*,¹⁰ which is an attempt to protect, anesthetize, all the nerve centers, central and local, this anesthesia contributing not only to the immediate, local comfort of the patient but to his general well-being. Anoci association is accomplished by such a combination of anesthetics, narcotics, environmental management and surgical technique as is suited to the individual case.

While the methods of applying these various means of protection have varied with increasing knowledge and with the introduction of more refined methods of anesthesia, the underlying principle has remained the same: individualization of the patient. In each case, the method used, whether general anesthesia, analgesia, spinal or regional anesthesia, or local anesthesia, each combined with narcosis and general management, is that indicated by the general condition of the patient as well as by the particular lesion.

It should be emphasized that no anesthetic method is standardized. It never can be standardized. That is, no one type of anesthesia is suitable for every type of case.

INHALATION ANESTHESIA

In our opinion, which is based upon studies of the effects of the different anesthetic agents upon the cells of the central nervous system, the lipoid solvent anesthetics, ether and chloroform, are contraindicated in bad risk cases, and that in any case, nitrous oxide-oxygen is the anesthetic agent of choice.

Twenty years ago, I believed that nitrous oxide plus oxygen was the inhalation anesthetic which when combined with local anesthesia provided the greatest protection to the cells of the central nervous system. I still believe that nitrous oxide-oxygen is the inhalation anesthetic of choice, but that only in the exceptional case should even this form of anesthesia be advanced beyond the stage of analgesia. Paradoxical though it may seem, the more serious the risk, the less the amount of inhalation anesthetic that should be administered. It should be borne in mind that bad-risk patients can not with entire safety endure even the mild degree of suboxidation that results from surgical nitrous oxide-oxygen anesthesia. The types of cases of which this is particularly true are starved and toxic cases: cases of obstruction of the pylorus, of cancer of the large intestine and of diseases of the gall bladder and common duct. The danger of complete anesthesia, even with nitrous oxide-oxygen, is especially manifested in cases of severe hyperthyroidism. In all bad-risk cases the anesthesia is harmful to the extent to which it interferes with the internal respiration, especially the internal respiration of the liver, the myocardium, and the brain.

In 1880, Klikowitch employed nitrous oxide-oxygen to lessen the pains of childbirth, and from the time of the old nitrous oxide "frolics" it has been known that minor injuries could be sustained without resultant pain after the inhalation of small amounts of this gas. Nitrous oxide analgesia has long been employed in dentistry and in minor operations. It is a remarkable property of nitrous oxide-oxygen analgesia that the patient, although freed to a considerable degree from pain,

and separated from his emotions, at the same time retains his intellectual control. The state of analgesia can be continued throughout the longest and severest operation on a very sick patient without bad results.

Anesthesia with nitrous oxide-oxygen anesthesia is safe; analgesia is safer. In 1914, Dr. Teter, Miss Hodgins and her associates at Lakeside Hospital had already administered nitrous oxide-oxygen 34,964 times without a fatality,¹¹ and among the thousands of operations performed since that time in my service at Lakeside Hospital and in the Cleveland Clinic, there has been no fatality. By keeping the degree of anesthesia within the zone of analgesia, the utmost safety is assured. The extreme safety of analgesia is found in the fact that nitrous oxide analgesia does not interfere with the internal respiration of the cells.

LOCAL AND REGIONAL ANESTHESIA

It has been said that the ancients, especially the Egyptians, possessed agents for the production of local anesthesia. The anesthetic value of the local application of cold has long been known. The compression of nerve trunks as a means of producing local anesthesia was practised by the Arabs, and was used by Paré and by many other operators, both ancient and modern, and in recent years attempts have been made to revive this practice.

In 1853, Alexander Wood, by the introduction of the hypodermic syringe, made possible the application of drugs directed upon the nerve endings; in 1884 Koller demonstrated the anesthetic property of cocaine, the value of which, as an operative aid in minor operations, was shown first by Halsted¹² and Corning.¹³ Halsted showed that when cocaine was injected into any part of a nerve trunk, sensory stimuli to any part of its peripheral distribution were blocked. This finding led to the later development of regional anesthesia, the value of which in major operations was later developed by Matas and others.

As Labat¹⁴ has emphasized, a thorough knowledge of anatomy is essential for the successful application of regional anesthesia since the method implies primarily the injection of nerves in all parts of the body. Novocaine, the anesthetic properties of which were first demonstrated by Braun,¹⁵ is the anesthetic agent of choice. Practically any operation on the head may be performed under regional anesthesia. In operations on the neck, local infiltration plus nitrous oxide-oxygen analgesia is most satisfactory. One avoidable objection to the use of regional anesthesia in operations on the neck is that the laryngeal nerves may become paralyzed, this resulting in certain discomfort and possible danger to the patient. The cervical plexus may be blocked, however, for block dissection of the glands of the neck. For operations on the upper extremity, the upper brachial plexus may be blocked, and for operations upon the thorax, such as rib resection, the paravertebral and intercostal nerves may be injected.

My associates and I employ regional anesthesia in combination with nitrous oxide analgesia as an infiltration before the first incision. Splanchnic anesthesia is employed in most operations on the gall bladder and stomach, in internal operations on the appendix, and in certain pelvic operations. Splanchnic anesthesia should be used with caution in operations on the genitourinary tract, as in many cases requiring such operations the patients have an impaired renal function.

It should be borne in mind that the personality of the patient must always be considered. In the case of a nervous patient who is fearful and unduly anxious, it may be necessary to employ local infiltration and nitrous oxide analgesia, or to employ the latter measure with the regional and splanchnic block. If the patient is excitable, it may even be necessary to let the analgesia pass into anesthesia for a brief period.

It is well to emphasize again that the type of anesthesia to employ, or rather the combination of anesthetic methods to employ, depends upon the individual patient. Even the habitus of the patient has some bearing upon the problem as it

is easier to locate the regional centers in patients of the long, lean type.

In the presence of cardiac or circulatory disturbances, or in cases of impaired renal function, regional anesthesia, as has been stated, must be used with caution. The value of spinal anesthesia in such cases will be discussed later.

SPINAL ANESTHESIA

I believe that Corning was the first to suggest the injection of cocaine into the neighborhood of the spinal cord as an anesthetic method. In 1885 he published his paper on "Spinal Anesthesia and Local Medication of the cord."¹³ Corning continued his investigations, and various other authors published papers dealing with different aspects of the problem of introducing medicinal fluids into the subarachnoid spaces. However, it was not until 1899 that the feasibility of spinal anesthesia was finally established by the work of Bier.¹⁶

According to Gwathmey, the first surgical operation under spinal anesthesia was performed by Tait and Cagliari on October 26, 1899, just ten days after the anniversary of the first public demonstration of ether anesthesia.¹⁷ Originally, the method was used only for operations on the lower extremities. There are various reports of the use of this new method in 1900. In that year, Lower successfully amputated a leg, in a case of diabetic gangrene, under spinal anesthesia, according to the method we had employed in the laboratory for blocking the spinal cord in dogs. Anesthesia was complete, there was no shock, and the patient made a complete recovery.¹⁸

Spinal anesthesia is of special value in operations in bad-risk cases, when the lower abdomen or lower extremities are involved. Thus, it may be employed to great advantage in amputation of the thigh or hip, in resection of the large intestine or rectum, in cases of obstruction of the bowels, in cases of large ventral or other hernia, especially in obese subjects, in prostatectomy, in resection of the bladder, in certain difficult kidney operations, especially in bad risks. Spinal anesthesia

is not free from danger since it encroaches upon vital functions. It should always be used by experienced operators, the Trendelenburg position must always be employed; the blood pressure must always be controlled. In expert hands, when all precautions are employed, it can be used with safety. Labat¹⁹ lists the principal dangers encountered in the use of spinal anesthesia as follows:

The higher the *puncture*, the greater the risk of injuring the cord and causing extensive functional disorders. The higher the *level of analgesia*, the greater the danger of severe complications which may result in respiratory failure. The higher the *segmental analgesia*, the greater the risk of upsetting the cardiovascular and respiratory balance, as a result of interference with the extrinsic mechanisms of circulation and respiration.

He says further:

Puncture of the spine and injection in the cervical and upper dorsal regions being associated with comparatively greater risks than elsewhere, the induction of spinal anesthesia routinely for operations upon the head, neck and thorax unnecessarily increases the burden imposed upon the patient by the operative procedure itself.

The use of spinal anesthesia for such operations as can be performed satisfactorily with other procedures of the regional method introduces into the general practice of surgery undesirable elements in the estimation of operative prognosis.

The induction of general analgesia by subarachnoid block for operations upon the head, neck and upper thorax is out of proportion to the extent of the surgical intervention and is clinically unsound.

The induction of spinal anesthesia for operations below the diaphragm is absolutely safe when all the details of technic are scrupulously observed.

The combination of details of technic taken from different sources is considered unwise and may lead to deplorable results.

Contraindications to the use of spinal anesthesia being based chiefly upon physiologic considerations, it is of the utmost importance that these considerations be well known so as to avoid disaster.

Any technic which is based on the principle of diffusion or gravitation of the injected fluid to the brain introduces into the method one of the biggest adverse factors in the achievement of end-results.

Any technic which implies the injection of solutions precluding the use of the Trendelenburg position immediately after the injection is detrimental to health and may endanger life.

Any technic which involves control of the level of anesthesia in utter disregard for the protection of the patient against acute anemia of the brain is dangerous to life.

Any technic which rests upon the fundamental principle of circulatory disturbances and attempts to cushion by posture the abruptness of such disturbances is of the highest clinical value.

At first we used novocaine in spinal anesthesia, but now we employ the solution introduced by Pitkin: spinocain. In general, we employ Pitkin's technique for its introduction, with the modification suggested by T. E. Jones²⁰ that we have the patient assume the prone position during the injection of the spinocain. This is done for the reason that since the solution is lighter than the spinal fluid, by this maneuver it is brought more surely into contact with the nerve roots. The field of anesthesia can be followed by lightly pricking the patient. As soon as the anesthesia has extended as far as is necessary for the operation, the patient is turned on his back and placed in the Trendelenburg position at an angle of from 5 to 10 degrees, this position being continued after the operation. This is important as a means of avoiding anemia of the brain as the result of the lowered blood pressure which follows the introduction of the anesthetic into the subarachnoid spaces. We generally make the puncture between the third and fourth interspace.

We have had no deaths which could be attributed to the use of spinal anesthesia. Since it involves vital functions, however, it should always be borne in mind that spinal anesthesia is not free from danger and its use should be accompanied by every precaution. The greatest menace of spinal anesthesia is lowered blood pressure. To obviate this danger, ephedrin in 1 grain dosage is given before the injection of the spinocain, and if necessary the dose is repeated during and even after the operation. Four or 5 drops of adrenalin, although more fleeting in its effects than ephedrin, is more effective, after the spinocain has been injected. The Trendelenburg position will guard the patient from the danger of anemia of the brain due to the lowered blood pressure.

GEORGE W. CRILE

NARCOTICS

We have referred to the preoperative administration of a narcotic as part of the essential procedure of anoci association. This procedure is particularly important when regional or spinal anesthesia is employed, as it protects the patient from the psychic effects of the sights and sounds in the operating room. We give morphine and scopolamine (morphine $\frac{1}{4}$ to $\frac{1}{6}$ grain, atropine $\frac{1}{150}$ grain), at least an hour before the operation, to all patients except the aged, the very young, and those whose feeble condition contraindicates the use of narcotics. Not only does the use of morphine diminish to some extent the and operative strain, but it prevents to some extent the damaging of the central nervous system and the liver by the trauma of the operation. That deep morphinization will almost completely prevent shock has been abundantly proved in both the laboratory and the clinic.

The value of morphine is especially exemplified in cases of severe hyperthyroidism. In those cases of infection in which it is necessary to perform an emergency operation, morphine is especially useful. In such cases, the morphine protects the brain against injury from the infection as well as against trauma from the operation.

A word should be added regarding the use of quinine and urea hydrochloride. When it is probable that there will be much postoperative discomfort, this agent may be injected at a distance from the line of incision, either immediately after the operation, or later, should pain develop. Since we have adopted the use of diathermy as a routine measure during and after extensive abdominal operations, it has rarely been necessary to employ quinine and urea hydrochloride. It should be borne in mind that this drug when injected in the line of the incision produces local edema and thus interferes with healing, so that the dictum *at a distance from the line of incision* should be strictly followed.

SUMMARY

The principle enunciated under the term "anoci association" still holds. The original methods employed have been altered to meet the advancing knowledge established by clinical observations and experimental research.

The scope of regional and of spinal anesthesia is extending; the role of the inhalation anesthetic is being progressively lessened, and when used it is kept as far as possible within the zone of analgesia, or at least, above the zone of the old ether chloroform narcosis.

The principle of anoci association implies such a combination of anesthetic methods: general, local, regional, spinal, of narcotics and general management, as are best suited to the individual case.

Anesthesia, like anoci association, can never be standardized; its application must always be individualized.

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TOTAL RHINOPLASTY*

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THE art of reconstructing a nose destroyed by certain tuberculous or syphilitic lesions, through trauma or surgical amputation, is as old as surgery itself.



FIG. 1.

When the destruction is partial and affects only the wings of the nose, or the lower septum, small cutaneous strips may be taken from the neighboring tissues; when these are sound, but

* For original French text see p. 309.

when the entire nasal structure must be replaced, a total rhinoplasty is required, necessitating the taking of a considerable portion of skin from a distant quarter.



FIG. 2.

There are two classic methods of procedure. The first is derived from the Indian method. It consists in removing from the forehead a broad strip, provided first of all with cartilage and having a pedicle attached to the intersuperciliary region. This strip is then pivoted about its own pedicle in order to lower it and to adapt it to the freshened-up substance at the point of loss. This procedure has the drawback of leaving ugly scars on the forehead.

The second procedure, derived from the Italian method, consists in taking a strip of skin from the arm, which is held flexed on the head by a special apparatus. This process has the



FIG 3.

double drawback of being unpleasant for the patient and of furnishing a strip of skin which both in texture and hue contrasts unpleasantly with the color of the face.

The procedure which I have gradually developed and which I now employ is derived jointly from the Indian and the Italian methods, with the added principle of strips with double tubulated pedicles, in the manner suggested by my lamented teacher, Morestin, and of Gillies, of London.

This procedure assures better nutrition of the strip, which is taken from the central portion of the forehead above the

roots of the hair, and which may be lowered directly by means of two tubulated temporal pedicles. After nutrition of the graft is assured, one needs only to cut the pedicles and restore them



FIG. 4.

to their place. The scars are hidden in the hair and this rhinoplastic method may therefore be regarded as the least disfiguring.

The principle of the method consists, therefore, in preparing the pedicles beforehand by suturing their two edges one to the

other. This preliminary rolling of the pedicles, converts them into genuine tubes, and will later facilitate considerably the irrigation of the graft. The graft is later cut between the two

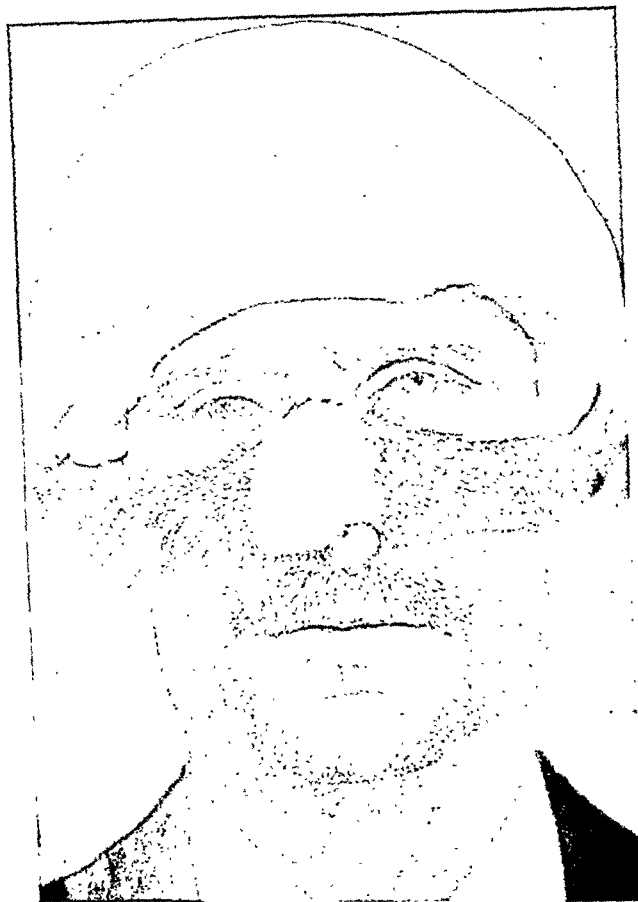


FIG. 5.

tubulated pedicles; the blood supply is thus conducted directly to it without suffering damage along its course.

OPERATIVE TECHNIQUE

1st Session. This comprises preparation of the two temporal pedicles, which are cut and tubulated, care being taken not to injure the trunk of the temporal artery at their base. The pedicle is cut by means of two parallel incisions, freed along its

entire length, and then tubulated, and the two edges sutured to each other. The cut surface resulting from the severing of the pedicle should be covered with iodoform gauze and the



FIG. 6.

dressing renewed as infrequently as possible. According to conditions, one or both of the pedicles may be prepared at a single sitting.

2d Session. Eight to ten days later, dissection and removal of the frontal strip is accomplished with reservation of a small median quadrilateral for the lower septum and two lateral



FIG. 7.

ailerons for the wings of the nose. (Fig. 1.) Freshening-up of the periphery of the loss of nasal substance and cutting of a small median strip as an upper joint, or hinge, to be attached to the small frontal strip, is next done, followed by the placing of the frontal strip, pivoted on its two temporal pedicles.

3d Session. When, after two weeks, the nutrition of the strip seems assured through its own blood supply, the two pedicles may be cut successively, with an interval of a few days, and placed in position, after being split and spread out and after the edges of the loss of cranial substance have been freshened up and freed. By stretching the pedicles gently, it is possible to cover up almost entirely the loss of substance, the central portion of which closes, either spontaneously or through the annexing of a dermo-epidermic lamella.

4th Session. This comprises adaptation and modeling of the strip by successive retouching with the aim of trimming and rounding the wings of the nose so as to render the nasal orifices permeable. It is, moreover, necessary for several months to leave rubber tubes in the nostrils until their interior epidermization is complete.

The wings of the nose, according to the case, should be completely molded and rolled up as far as the lower septum, or merely sutured to the root of the normal wing, if the latter has been spared by the trauma.

Among the necessary retouchings, depilation of the transplanted strip is important. In the effort to insure extirpation of the hairs, I have abandoned the use of x-rays and electrolysis and employ a surgical method of depilation which seems to me simpler and more radical. This method consists simply in destroying the pilous bulbs by means of a sharp curette and scissors curved to the lower face of the strip. This extirpation should be carried out in successive sessions, either before lowering the graft, or at the time of the definite adaptation of the graft.

It is preferable not to leave cartilage attached to the strip, but later to introduce a small piece of cartilage into the body of the graft, if the latter tends to give way.



FIG. 8.



FIG. 9.

The results obtained by this procedure are satisfactory.

Total or subtotal rhinoplasty, by the method of a median frontal strip, with double tubulated pedicle always involves five or six operative sessions which may be carried out under local anesthesia. Three to four months must be allowed for its complete execution.

LA RHINOPLASTIE TOTALE *

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L'ART de refaire un nez détruit par certaines lésions tuberculeuses ou syphilitiques, par un traumatisme ou par une exérèse chirurgicale, est aussi vieux que la chirurgie.

Lorsque la destruction est incomplète et porte seulement sur les ailes du nez ou sur la sous-cloison, on peut emprunter de petits lambeaux cutanés prélevés sur les tissus voisins lorsqu'ils sont sains; mais lorsqu'il faut remplacer toute la pyramide nasale, la rhinoplastie totale doit emprunter un vaste lambeau de peau prélevé au loin.

Deux procédés demeurent classiques: le premier est dérivé de la méthode indienne. Il consiste à prélever sur le front un large lambeau, armé au préalable de baguettes cartilagineuses et dont le pédicule siège dans la région intersourcilière; à faire pivoter ce lambeau autour de son pédicule pour le descendre et l'adapter sur la perte de substance avivée. Ce procédé a l'inconvénient de laisser sur le front de vilaines cicatrices.

Le deuxième procédé, dérivé de la méthode italienne, consiste à prélever le lambeau cutané sur le bras maintenu en flexion sur la tête par un appareil spécial. Ce procédé a le double inconvénient d'être très incommode pour le patient et de fournir un lambeau de peau dont le grain et la couleur tranchent désagréablement sur la couleur du visage.

Le procédé que j'ai mis progressivement au point et que j'emploie actuellement, dérive de la méthode indienne et de la méthode italienne, empruntant, en outre, le principe des lambeaux à doubles pédicules tubulés, à la façon de mon regretté maître Morestin et de Gillies de Londres.

* For English Translation see p. 298.

Ce procédé assure une meilleure nutrition du lambeau qui est taillé sur la partie moyenne du front, à cheval sur la racine des cheveux, et qui peut être descendu directement à l'aide de deux pédicules temporaux tubulés. Lorsque la nutrition du greffon est assurée, il suffit de sectionner les pédicules et de les remettre en place. Les cicatrices sont ainsi dissimulées dans les cheveux et ce procédé de rhinoplastie peut, de ce fait, être considéré comme le moins mutilant.

Le principe de cette méthode consiste donc à préparer les pédicules dans un temps préliminaire, en suturant respectivement l'un à l'autre leurs deux bords. Cet enroulement préalable des pédicules transformés ainsi en véritables tubes va favoriser considérablement l'irrigation du greffon qui sera taillé ultérieurement entre les deux pédicules tubulés, car le sang lui sera conduit directement sans subir aucune perte le long de sa route.

TECHNIQUE OPERATOIRE

1^{er} Temps—Préparation des deux pédicules temporaux qui sont taillés et enroulés en ménageant à leur base le tronc de l'artère temporale.

Le pédicule sera taillé à l'aide de deux incisions parallèles, décollé dans toute son étendue, puis enroulé, et ses deux bords seront suturés l'un à l'autre. La surface cruentée résultant de la taille du pédicule sera recouverte de gaze iodoformée et le pansement renouvelé le moins souvent possible. On peut, suivant les cas, préparer dans la même séance un seul ou les deux pédicules.

2^{ème} Temps—Huit à dix jours après, dissection et décollement du lambeau frontal en ménageant un petit quadrilatère médian pour la sous-cloison et deux ailerons latéraux pour les ailes du nez (Fig. 1).

Avivement de la périphérie de la perte de substance nasale et taille d'un petit lambeau médian à charnière supérieure qui sera opposé au petit lambeau frontal.

Mise en place du lambeau frontal basculé autour de ses deux pédicules temporaux (Fig. 2).

3ème Temps—Lorsque, après quinze jours, la nutrition du lambeau paraît assurée par son irrigation propre (Fig. 3), on peut sectionner successivement l'un et l'autre pédicules à quelques jours de distance et les remettre en place après les avoir fendus et étalés et avoir avivé et décollé les bords de la perte de substance crânienne. En les étirant légèrement, on arrive à recouvrir presque entièrement cette perte de substance dont la partie centrale se ferme soit spontanément, soit par adjonction d'une lamelle dermo-épidermique.

4ème Temps—Adaptation et modelage du lambeau par des retouches successives qui ont pour but de tailler et d'enrouler les ailes du nez afin de rendre perméables les orifices nasaux. Il est d'ailleurs nécessaire de laisser durant plusieurs mois des tubes de caoutchouc dans les narines jusqu'à leur complète épidermisation intérieure.

Les ailes du nez seront, suivant les cas, complètement façonnées et enroulées jusqu'à la souscloison, ou seulement suturées avec la racine de l'aile normale lorsque celle-ci a été ménagée par le traumatisme.

Parmi les retouches nécessaires, il est important d'épiler le lambeau crânien transplanté. Pour obtenir la chute définitive des poils, j'ai renoncé aux rayons X et à l'électrolyse, pour employer un moyen chirurgical d'épilation qui me paraît plus simple et plus radical. Ce moyen consiste simplement à détruire les bulbes pileux, à l'aide d'une curette tranchante et de ciseaux courbes par la face profonde du lambeau. Cette destruction doit s'effectuer par temps successifs, soit avant de descendre le greffon, soit au moment où l'on procède à l'adaptation esthétique définitive du greffon.

Il est préférable de ne pas armer le lambeau de cartilage et de glisser ultérieurement une petite baguette de cartilage dans l'épaisseur du greffon s'il a tendance à s'affaisser.

Les résultats obtenus par ce procédé sont satisfaisants.

La rhinoplastie totale ou subtotale par le procédé du lambeau frontal médian à double pédicule tubulé, comporte, toujours cinq ou six temps opératoires qui peuvent s'exécuter à l'anesthésie locale. Il faut compter environ trois à quatre mois pour son exécution complète.

FISTULAS FOLLOWING THE MARSUPIALIZATION OF HYDATID CYSTS

THEIR RADIOGRAPHIC EXAMINATION*

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THE stubborn biliary fistulas that remain as the result of the opening and marsupialization of hydatid cysts are much more frequent than would be desired. This occurs especially in infected cysts in which no other procedure can be carried out and these are the most difficult to treat.

In the simple uninfected cysts, even when the marsupialization is used, these fistulas are less frequent, as in these the cholerrhagia during the first days following operation has a marked tendency to spontaneous healing because the fistula is produced by the rupture of the small biliary channels, some of them microscopic.

This easy healing contrasts with the numerous fistulas that we observe after operation on cysts that have ruptured into the biliary tract or have suffered any infection coming from the same tract.

The mechanism of the persistent cholerrhagia in these stubborn fistulas is due to various causes, among which we mention the two most important:

1. The fistula may be due to an obstacle in the main passage: the common duct.
2. The fistula may be due to a pathologic communication of the cyst cavity with a biliary channel of gross diameter.

The study of the causes and the diagnosis of their nature and localization can be made now, not only by clinical and laboratory findings, but by means of radiographic study of the biliary tract after the injection of lipiodol.

*Translated by Dr. John Rodick and Dr. Loyola. For original Spanish text see p. 323.



FIG. 1. Lipiodol has penetrated freely up to duodenum, outlining clearly intrahepatic tracts, and shows cystic duct, duct of Wirsung, and other large ducts without any cyst remains.

1. *Fistulas from Obstruction of the Main Channel:* The compression is most frequently originated by intact hydatids or remaining membrane which act as a tampon of gelatinous consistency and obstruct the choleduct and partially the hepatic duct. This obstruction is rather frequent, since rupture into the biliary channels can be considered as one of the most common accidents.

When these hydatids issue from the cyst that has been evacuated and marsupialized, they disappear rapidly, the obstruction being temporary, since there are numerous discharges through the choleduct and papilla of Vater which are accompanied by a more or less accentuated clinical picture during which the hydatids can be demonstrated by straining the feces.

Notwithstanding, the principal passage does not always remain clear in spite of the discharge but at times the obstruction persists; this is demonstrated by persistent acholia, and at times by the same jaundice which had diminished with the opening of the operated cyst, and in all these cases we should think of the possibility of the existence of other cysts also opening into biliary tracts which may continue supplying the sacs that constitute the obstruction of the principal passage. It is always worthy of consideration that the proliferation of the cysts is reactivated when they come in contact with the bile, and there is noticed in most of the cases an increase in number of the daughter cysts lying by the side of the dead cysts. Lozano of Zaragoza, who has so wide an experience in hydatid disease, because it is very frequent in the country where he works, believes that the parasite is biliophilic, but we are rather inclined to believe as more probable in a proliferative reaction of defense which, undoubtedly, overcomes the not less evident toxic action that the bile has on the parasite.

The obstruction is not always intrinsic; we have had occasion to observe compression of the main duct by extrinsic pressure caused by a cyst located somewhere at the spigelian lobe or at the quadrate lobe.



FIG. 2. Same patient seen in profile.

2. *Fistulas without Obstacle in the Main Biliary Duct:* In some cases, the biliary fistula persists, although we cannot find, after the marsupialization, any obstacle in the biliary channels. In fact, we can obtain bile by the duodenal tubage; the feces are more or less colored with bile, and notwithstanding this, the fistula has no tendency to heal. It is true that in these cases, we can almost always control the cholerrhagia temporarily with a tight tampon of the fistulous tract, but nevertheless the fistula persists indefinitely causing great despair to the patient and marked worry to the surgeon. The roentgen examination in these cases shows a free communication of the cyst with the biliary tract without alteration in its form and direction, and the lipiodol passes freely to the duodenum through the ampulla of Vater.

Clinical Exploration of Biliary Fistulas following the Marsupialization of an Hydatid Cyst: We should employ, at first, the methods which may give a certain orientation. The investigation of the presence of bile in the feces or the straining of these to look for hydatid membranes, could cause us to think of an obstruction of the biliary ducts provided that the lack of bile in the feces and the presence of membranes remain constant. Nevertheless the hydatid tampon may allow some bile to pass and the hydatids may be unnoticed on account of its being inconstant.

The radiological exploration, on the other hand, will give us much more positive information.

After several observations of Lanari and Squirru,² of Cotte and Badolle,³ of Lefevre Monties⁴ in 1925 and of several other authors at present, we have used systematically lipiodol injection in all fistulas following marsupialization, and in every case we have had definite evidence of the conditions which caused the persistent cholerrhagia.

When there is an obstacle in the main duct, it is observed that the lipiodol stops when it reaches the obstacle with a level more marked than that produced by a stone, which may be seen sometimes in the radiograph.



FIG. 3. Lipiodol enters gall bladder by means of Pezzer catheter, then passes through cystic duct and after filling junction between large intrahepatic ducts comes to rest at choleduct which is impermeable because of retained membranes.

When the choleduct is free, we see the lipiodol passing easily into the duodenum; this does not happen with all the bile, which can not force the sphincter of Oddi, if there is communication with a bile duct of large diameter.

As an example of the usefulness of the radiographic examination in these cases, we reproduce four radiographs:

The first and the second belong to a patient, thirty years old, who had a pyopneumocyst, with fetid pus, and at the end of one year, still had intense cholerrhagia by the orifice of the marsupialization. Both anteroposterior and lateral radiograms show clearly that the lipiodol passes easily to the duodenum, and we found the biliary ducts normal regarding their form, diameter and direction. This patient was treated by making the closure of the fistulous tract in the same way that an intestinal fistula is closed; the patient was cured in a few days.

The third and fourth radiographs are of a woman who presented a clinical picture of acute cholecystitis after childbirth, and notwithstanding her jaundice was treated only by cholecystostomy since the gravity of her condition did not permit of more prolonged intervention. The patient improved but not entirely, the bile continuing to flow from the fistulous tract without any of it passing into the intestine. After the radiologic exploration preceded by lipiodol injection, there was found a complete obstruction of the choleduct. When the patient was operated upon, the choleduct was opened and numerous hydatids came out, some partly disintegrated and others alive, which formed a gelatinous tampon which hermetically sealed the lumen of the choleduct. Drainage was established in the choleduct but the original cyst from which the obstructing hydatids arose was not found. The patient died and at necropsy a hepatic cyst was found which did not elevate the surface of the liver even though it was not very deep.

Certainly the patient would have survived if, instead of draining the choleduct, we could have performed a cystostomy with marsupialization of the cyst which was also suppurative.



FIG. 4. Same case, radiograph taken laterally.

SURGICAL TREATMENT OF BILIARY FISTULAS FOLLOWING
MARSUPIALIZATION OF HYDATID CYSTS

Following radiologic findings, we are able to determine the logical treatment.

1. *Cases in Which There Is No Obstruction in the Main Channel:* In this case we close the cyst or the biliary channel which it represents with a technique similar to the one employed in radical treatment of artificial anus.

In one of the patients operated upon by us under these conditions, the cyst had a tubular form united to the skin in the form of a rigid tube with a narrow lumen; once the skin was closed by a purse string suture we could dissect the tube formed by the remains of the cyst wall, section it, suture it in various planes, cover it with peritoneum and leave it united to the wall with incomplete closure, in case breaking down should occur.

2. *Cases in Which the Radiograph Indicates an Obstruction in the Principal Passage:* There has been much discussion among surgeons over the preferable method of treating the jaundice from obstruction by the echinococcus. The opening of the choleduct, so highly recommended by the French surgeons to evacuate the principal bile tracts as a prime indication, here loses a great part of its value because of the existence of the cholerrhagia which makes the drainage unnecessary. Furthermore as the result of our observations, we are firmly convinced that always after the opening of the cyst the obstruction in the choleduct persists a long time, which indicates the repeated passage of new hydatids supplied by an unevacuated cyst. Multiple cysts are very frequent and the persistence of the obstruction usually means the existence of an undiscovered cyst which acts as an inexhaustible source of new hydatids which travel through the biliary passages. We should also remember that cysts are not always visible by abdominal exploration nor even by laparotomy, so that in no case should we neglect the exploration of the dome of the right diaphragm because the alteration and modification of its form

may, in some cases, indicate the existence of a suprahepatic cyst.

All these cases should be approached through the pleura and diaphragm, as especially studied by Petridis, to reach the hepatic abscesses, as it is the only sufficiently guaranteed way to approach the posterior and superior regions of the liver.

The evacuation by means of cystotomy as upheld by our South American colleagues is the only radical effective intervention to secure relief of the obstruction of the choleduct in a definite manner.

CONCLUSIONS

1. The persistence of cholerrhagia after marsupialization of hydatid cysts depends upon two causes: the prolonged indefinite existence of hydatids in the choleduct or the opening into the cyst of a large biliary channel.

2. Only radiography of the fistulous tract, after lipiodol injection, can give us assurance of the cause which maintains the cholerrhagia since clinical examination is not always definite.

3. The prolonged persistence of hydatids in the choleduct nearly always indicates the presence of an unevacuated cyst and the only treatment which offers any guarantee is the evacuation of the cyst.

4. When the cholerrhagia depends upon the opening of a large intracystic biliary channel, the treatment should be like that for radical cure for artificial anus.

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LAS FISTULAS CONSECUTIVAS A LA MARSUPIALIZACIÓN DE LOS QUISTES HIDATIDICOS: SU EXPLORACIÓN RADIOGRAFICA*

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LAS fistulas biliares rebeldes que quedan como consecuencia de la abertura y marsupialización de los quistes hidatídicos, son mucho mas frecuentes de lo que seria de desear. Es precisamente en los quistes infectados, en los que nos está vedado emplear otros procedimientos, en los que se presentan estas fistulas con mayor dificultad para su curación.

En los quistes simples, *no infectados*, aun empleando la marsupialización son poco frecuentes estas fistulas, ya que en ellos la *colerragia* de los primeros dias despues de operados, tiene una marcada tendencia a la curación expontánea, por estar producida por la ruptura de pequeños canaliculos biliares, algunos de ellos microscópicos.

Contrasta con esta facilidad de curación el número de fistulas que observamos despues de operar quistes que han sufrido un accidente de ruptura en las vias biliares o una infección cualquiera de las mismas.

El *mecanismo* de la persistencia de la colerragia, constituyendo estas fistulas rebeldes, obedece a diversas causas, entre las cuales distinguiremos dos principales.

Primera. La fistula puede ser debida a un obstáculo de la via principal hepato-coledociana.

Segunda. La fistula puede ser debida a una comunicación patológica de la cavidad quística con un conducto biliar de grue so calibre.

El estudio de estas causas y el diagnóstico de la naturaleza y localización de las mismas, podemos hoy dia efectuarlas no

* For English translation see p. 313.

solo por los signos clínicos y de Laboratorio, sino principalmente por medio del estudio radiografico de las vías biliares previa la inyección de lipiodol en el interior de las mismas.

Fistulas por obstrucción de la via principal. La compresión estará originada las mas de las veces por hidátides enteras o por restos de membranas que a modo de tapón de consistencia gelatinosa obstruyen el colédoco y parte del hepático.

Esta obstrucción es bastante frecuente, ya que la ruptura dentro de las vías biliares, puede consideraase como uno de los accidentes mas frecuentes.

Cuando estas hidátides proceden del quiste que ha sido evacuado y marsupializado, se agotan rapidamente, siendo la obstrucción *temporal*, ya que nunca faltan varias desgargas coledoco-vaterianas, que van acompañadas de un cuadro sintomático mas o menos acentuado en el cual podemos comprobar la *hidatidenteria* por el tamizado de las heces.

No obstante no siempre queda libre el conducto principal a pesar de dichas descargas, sino que a veces persiste la obstrucción que se demuestra por la persistencia de la acolia, a veces de la misma ictericia, que habia disminuido con la abertura del quiste operado y en todos estos casos debemos pensar en la posibilidad de la existencia de otro quiste abierto tambien en vías biliares que vaya renovando las vesiculas que constituyen el obstáculo de la vía principal. Es siempre digna de tenerse en cuenta la reactivación prolígera de todo quiste que ha sido puesto en contacto de la bilis, notándose en la mayor parte de los casos el aumento de vesiculas hijas, al lado de vesiculas muertas. Lozano de Zaragoza,¹ que tiene gran experiencia en hidatidosis, por lo frecuente que es esta enfermedad en la región que ejerce, habla de una *biliofilia* del parásito, pero nosotros nos inclinamos a creer que mas bien se trata de una reacción proliferativa de defensa, que indudablemente sobrepasa a una, no menos accidente acción tóxica, que la bilis ejerce sobre el parásito.

No siempre la oclusión sera interior, pues hemos tenido ocasion de observar compresiones de la vía principal por

presión extrínseca ocasionada por un quiste localizado en un punto del lóbulo cuadrado o del de Espigelio.

Fistulas sin obstáculo en la via principal de las vias biliares. En algunos casos, persiste la fistula biliar, sin que se pueda encontrar despues de la marsupializacion, ningun obstáculo en las vias biliares. En efecto, por sondaje duodenal se puede obtener bilis, los excrementos están coloreados, con mayor o menor intensidad y sin emba bargo, la fístula no tiene ninguna tendencia a la curación. Ciertó que en estos casos casi siempre podemos yugular temporalmente la colerragia con un taponamiento apretado del trayecto, pero de todos modos la fistula persiste indefinidamente, con gran desesperación del enfermo y marcada preocupación del cirujano. El exámen radiográfico en estos casos nos demuezsra una amplia comunicaci3n del quiste con las vias biliares sin que exista alteracion en la forma y direcci3n de las mismas, pasando libremente el lipiodol al duodeno, a traves de la estrechez vateriana.

Exploracion clinica en las fistulas biliares, cosecutivas a una marsupializaci3n por quiste hidatídico. El problema a dicidar en estos casos es la causa de la persistencia de la colerragia.

Utilizaremos ante todo los metodos clinicos que nos pueden dar una cierta orientaci3n. El examen de bilis en las heces y el tamizado de las mismas en busca de membranas, nos podrán orientar a suner un obstáculo de vias biliares siempre que la falta de materia biliares o la presencia de hidátides se presente de un modo repetido. No obstante, el tap3n hidatidico, puede permitir pasar cirtt cantidad de bilis y la hidatidenteria siendo intermitente, puede pasar iadvertida.

El método radiográfico nos dará por el contrario, datos de mucha mayor seguridad. Despues de varias observaciones de Lanari y Squirru,² de Cotte y Badolle³ de Lefevre Monties⁴ el año 1925 y de varios mas en la actualidad, hemos procedido sistematicamente a la inyecci3n con lipiodol de todas las fistulas consecutivas a las marsupializaciones y en todos los casos hemos obtenido un resultado muy evidente respecto a

las condiciones que originaban la patogenia de la persistencia en las colerragias.

Cuando existe un obstáculo en la via principal, se observa que el lipiodol, queda detenido a nivel del mismo, con un límite mas marcado que el que produce un cálculo que puede a veces ser apreciado por la misma radiografia.

Cuando el conducto principal está libre, vemos que el lipiodol pasa al duodeno con facilidad, lo que no ocurre con toda la bilis, que no puede forzar el esfinter de Oddi si hay una comunicación con un grueso conducto biliar.

Como ejemplo de lo demostrativo que resulta en estos casos el examen radiográfico, acompañamos las siguientes radiografia. La primera y segunda corresponden a un enfermo, de unos 30 años que tenia un pio neumo quiste, con pus fétido que al cabo de mas de un año todavia tenia una intensa colerragia a nivel del oricio de marsupialización. La radiografia tanto frontal como de lado, nos indican claramente que el lipiodol pasa al duodeno con la mayor facilidad, encontrandose unas vias biliares normales en cuanto a su forma, calibre y dirección. Dicho enfermo fue tratado por medio de la oclusión operatoria del trayecto fistuloso como si se tratase de una fistula intestinal, saliendo curado de la misma a los pocos dias.

Las radiografias tercera y cuarta pertenecen a una mujer que presentó un cuadro de colecistitis aguda despues de un parto y apesar de su ictericia fué tratada tan solo por colecistostomia ya que su estado de gravedad no permitia otra intervención mas prolongada. La enferma mejoró, pero no del todo, persistiendo la sal ida de bilis por el trayecto fistuloso, sin que pasase nada por el intestino. Efetuada la exploracion radiológica previa inyección de lipiodol, se aprecia una obstrucción completa de todo el coledoco. Operada la enferma, se abre el coledoco y salen numerosas hidátides, en parte esface-ladas y en parte vivas, que forman un tapón gelatinoso que ocluye hermeticamente la luz del coledoco. Se establece un drenaje del coledoco y no se encuentra el quiste originador

de las hidatides obstructivas. La enferma fallece y en la necropsia se aprecia un quiste hepatico que no produce relieve en la superficie del hígado apesar de no ser muy profundo.

Seguramente la enferma se hubiera salvado si en vez del drenaje de coledoco hubiesemos podido practicar una quistotomía con marsupialización del quiste, que por cierto era *suprado*.

Tratamiento quirurgico de las fistulas biliares consecutivas a la marsupializacion de los quistes hidatídicos. Despues de los datos proporcionados por el examen radiografico podemos plantear el tratamiento de un modo 'lógico.

1°. *Casos en los que no hay obstáculo en la via principal.* En este caso cerraremos el quiste o el conducto biliar que lo substituye con una técnica parecida a la que se emplea en el tratamiento radical de un ano contranatura.

Uno de los enfermos operados por nosotros en estas condiciones, tenia el quiste una forma tubular unido a la piel en forma de tubo rígido co una luz estrechada: una vez cerrada la piel en bolsa de tabaco, pudimos disecar el tubo formado por los restos de las paredes del quiste, seccionarlo, suturarlo en varios planos, cubrirlo de epiplon y dejarlo unido a la pared, con cierre incompleto, por si sobrevenia una dehiscencia de la misma.

2°. *Casos en los que la radiografia indica un obstaculo en la via principal.* Mucho se ha discutido entre los cirujanos sobre el metodo preferente para tratar las ictericias por obstrucción en la equinococia. Lax abertura del coledoco recomendada con gran calor por los cirujanos franceses⁴ para evacuar la via bilias principal como indicación primordial, pierde aquí gran parte de su valor, por existir una colerragia que suple dicho drenaje. Ademas como consecuencia de nuestras observaciones, tenemos el convencimiento arraigado de que siempre que despues de la abertura de un quiste persiste el obstaculo coledociano durante mucho tiempo, es indicio del paso renovado de *nueva hidatides* procedentes de un *quiste no evacuado*. Son muy frecuentes los quistes múltiples y la persistencia del

obstáculo, traduce las mas de las veces la existencia de un quiste desconocido que actua como manantial inagotable de nuevas hidátides que se vierten por las vías biliares. Debemos tambien recordar que no siempre loss quistes son perce tibles por la exploración abdominal ni siquiera por laparotomía, así que en ningún caso debemos descuidar la exploración de la bóveda diafragmatica derecha que por su alteración y modificación de forma nos indicará en algunos casos la existencia de un quiste supra hepatico.

Todos estos casos requeriran ser abordados precisamente por la vía transpleuro-diafragmática, preferentemente estudiada por Petridis para abordar los abscesos hepáticos, pues es la única que nos ofrece garantías suficientes para abordar esta región posterior y superior del higado.

La evacuación por medio de la quistotomía como sostienen nuestros colegas sud americanos,⁵ es la unica intervencion radical y eficaz para conseguir una desobstrucción del coledoco de carater definitivo.

Conclusiones. 1ª. La persistencia de la colerragia despues de la marsupialización de los quistes hidatidicos, depende de dos causas. La existencia prolongada e indefinida de hidátides en el conducto coledoco, o la abertura intraquistica de un grueso conducto biliar.

2º. Solo la radiografia del conducto fistuloso previa inyección de lipiodol nos puede dar la seguridad de la causa que mantiene la colerragia ya que el examen clínico no siempre es decisivo.

3ª. La persistencia prolongada de hidátides en el coledoco casi siempre indica la presencia de un quiste no evacuado y el solo tratamiento que ofrece garantas es la evacuacion del mismo.

4ª. Cuando la colerragia depende de la abertura de un grueso conductillo biliar intraquistico, el tratamiento será parecido al de la cura radical de un quano-contranatura.

PLACE OF THE SENSES IN THE DEVELOPMENT OF SCIENCE

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ORTHODOXY has its value. Unless a person is deeply interested in a search for truth in a special field, it is better for him to keep an open mind and, with "a decent respect for the opinions of mankind," travel with the majority, that his energy may be conserved to develop the work in which he has been trained. If he wishes to devote his life to a study of so-called psychic phenomena, it is one thing, but as a side line investigation of the occult carries distinct danger to integrity of thought. It loosens the mind from the moorings of fact, gives predominance to the lesser senses, and creates emotional disturbances which resemble the instinctive fear reactions of primitive man and the lower animals. One of these reactions was fear in the dark, which remains with us today as a source of emotional disturbance.

Man first recognized only enemies that were large enough to be seen and dangers that could be estimated visually, such as wild beasts, serpents and tempests. Against phenomena which he could not understand he invoked the protection of his gods.

Through association of ideas the words *cult* and *occult* have become closely allied. The cultist devotes his energy to spread a special belief not recognized by the majority as resting on a sound foundation. The occultist devotes his time to an attempt to elucidate a belief in hidden and mysterious powers having their origin in a spirit world and to subject them to human control.

Anyone dabbling in the occult, deliberately depriving himself of vision, man's chief means of obtaining information, injures himself mentally. It is a curious ego that in the clear

light of reason will prompt one to say of a certain subject, "I do not understand this," and in the dark of suggested psychic influences to say of the same subject, "I believe this is occult," in the sense of a mysterious spirit force. I have known a number of men of great promise in medicine who in the springtime of their lives became interested in a cult or in occultism of the old-fashioned spiritualistic type, which led them to unproved or unprovable hypotheses, blind alleys of belief. As a result, they lost their keen perception of fact and made little progress in their profession.

Sir Conan Doyle in his masterly characterization of Sherlock Holmes intrigued the interest of hosts of readers and established a school of detective fiction. Sir William Crookes, the last of the great all-around physicists, made investigations which led to the discovery of the cathode ray, the basis of the x-ray. Sir Oliver Lodge, who so clearly placed before the interested but untrained student the fundamental facts in physics, has the gratitude of all. These are three outstanding men of science who interested themselves in psychic phenomena and believed in reincarnation of the dead. This interest, however, came in the autumn of an intense scientific life. Their great days were over. The new interest was a foil to the critical research of the early days, like the contemplative philosophy of the Orientals.

There is a divine discontent with the existing order of things which leads to progress. Youth is always insurgent, a builder of images, a dreamer of dreams. When guided by scientific imagination youth builds images to be compared with known facts, and dreams true dreams. Age carries mental scars left by experience which contract and shorten vision, but age carries wisdom. Youth and age should travel together; each needs the other for orderly scientific advancement.

The man of 100 years ago who would have attempted to talk about radio and the wireless would have been regarded as mentally deranged. Had he been able to produce these phenomena they would have been considered occult manifestations from

the spirit world, and he probably would have been burned at the stake. Whenever we do not understand existing phenomena, let us lay the lack where it belongs, to the failure of understanding which the future may clear up, and not allow ourselves to prostitute intelligence by talking about fairies, ghosts, spirits, and reincarnation of the dead.

Science is organized knowledge of the physical world. Wisdom denotes a clear perception of facts and sound judgment in dealing with them. The man of science in searching for the truth must ever be guided by the cold logic of facts, and be animated by scientific imagination. Man's brain, the instrument devised to receive and interpret truth, depends on the senses as its main avenues of approach through which come the raw materials of the truth. Only as the accuracy of these special senses in transmitting the materials out of which truth is made, can be relied upon, can the resulting truth be relied upon. Science, therefore, owes much to the special senses. It seems fitting to pause in these days of the supremacy of science, to consider these special senses.

I shall, therefore, devote the remainder of this paper to two topics; first a consideration of the genesis and relative value of the special senses in obtaining information, and second the significance of vision in the evolution of one of the sciences, namely medicine.

THE SPECIAL SENSES

The brain of man, a social being, is dominant. It records and classifies impressions, analyzes experiences, and activates emotions.

Intellectual functions cannot be ascribed entirely to the special senses, but are rather the sum total of both external and internal sensory impressions woven into a complex mechanism controlling behavior.

The upper brain which contains the cerebral convolutions is the central organ which connects man with the outside world. This part of the brain might be picturesquely described as an

expansion of the primitive organ of the sense of smell, but this expansion has been devoted to vision whereas the sense of smell has diminished. The higher mammals, and especially man, have achieved direct pathways from the eyes to the cerebral convolutions, and the growth of the mind, so far as man is concerned, might be said to be coincidental with the development of vision. Stimuli of the sense of taste, of hearing, and of touch must figuratively pass through more relay centers to reach the brain, and therefore their interpretation may be inaccurate and misleading unless corrected by sight, just as a telephone message relayed through several stations may be garbled.

In the simplest forms of life external impressions are conveyed through the protective covering of the organism. In the invertebrate, the amphioxus, all the sense organs other than tactile are rudimentary or absent. The sense of touch, a pressure sense, is the most primitive of the special senses. In common parlance, touch refers to the hands, which the upright position of the human body has freed for highly specialized training.

At the Victoria Hospital in Newcastle-on-Tyne that sound English surgeon, Rutherford Morison, whose observations have been characterized by vision and acumen, has printed on the wall of his operating room facing his students, five words: "Sight," in large letters; "Touch," in smaller letters; "Hearing," in still smaller letters; "Smell," in fine print, and last "Taste," in print so small as to be scarcely distinguishable across the room, thus indicating his estimation of the five special senses in relation to surgery.

THE SENSE OF TASTE

The sense of taste is a chemical sense and in man is the least important of the special senses and the most imperfect. This sense is closely associated with the sense of smell, and most of the qualities known as flavors, prized by the epicure, are distinguished by the sense of smell, rather than by

the sense of taste. Without the sense of smell, the sense of taste cannot distinguish an onion from an apple. The sense of taste developed early, that the primitive organism might be able to recognize material unfit for food as well as edible material, and in man this sense has so little discrimination that it can detect only four types of food: sweet, sour, salty, and bitter.

THE SENSE OF SMELL

The sense of smell is also a chemical sense, extraordinarily accurate and highly developed; it detects odors which are entirely beyond discovery by any known scientific apparatus. Gases, and vapors representing material in a molecular or colloid state not only can be recognized but also correctly classified by the trained sense of smell. This sense, however, does not give appreciation of time, place, or motion.

The sense of smell depends on certain cells which end in a hair. These cells are arranged in small bundles about the base of which are pigmented cells. Newer knowledge of physics in connection with the radio, little as it is, gives a clue to the purpose of the hair endings. These delicate hairs may be compared to the antennae of a radio, recognizing the impact of electronic vibrations of rapidly moving colloids and unstably oxidized molecular substances suspended in the air as odors, just as the eyes recognize various wave-lengths of light as colors.

In man the organ of smell is situated deep and occupies a total area of only about one square inch. The relation of the sense of smell to the protection of the organism against poisonous contacts seems to depend on the pigmented cells at the base of the organ of smell. Sheepmen will not raise albino lambs but send them to the butcher, because they have no sense of smell and sooner or later would die from eating poisonous material.

The sense of smell, unlike the senses of sight and hearing, does not diminish with age, but often becomes more acute, and is keener in women than in men.

In the lower vertebrates smell is the only special sense that comes by direct pathways to the upper brain and is dominant in controlling behavior, meaning the relations of one animal to another of the same or a different species.

With the wind in the right direction, the distance at which a deer is able to detect danger by the characteristic odor of an enemy is almost incredible. And yet the infant deer during the first days of life is without odor, protected in some curious way against its enemies in the stage of its innocence. Wild beasts passing near will not discover the fawn, but will trail the mother.

In certain breeds of dogs, as the hounds, the organs of smell are enormously developed, but their sight is defective. The bird dog circles the object of his search, depending on the sense of smell for approximate location. He then points the cover of the game from the intensity of the odor, and finally secures sight of the object. A hound following a scent may run into a tree during the chase, and may bark at his master, unable to recognize him by sight at a distance of 100 feet.

THE SENSE OF HEARING

The sense of hearing in man is inaccurate. Whereas the senses of sight and smell will telephone, so to speak, directly to the brain, a sound to reach consciousness must be relayed through a number of extra stations, with all the possibility of confusion and inaccuracy that the process necessarily entails.

Fish have a sixth sense, situated in the lateral line organ of Leydig, which gives the sense of pressure, depth, and equilibrium, and from this labyrinth organ of the water vertebrate the organ of hearing in land animals developed. The ear of land animals responds to sound waves and pressure changes in the air as the lateral line organ of water vertebrates does to waves and pressure changes in water.

The inaccuracy of hearing due to the relay system of transmission of sound to consciousness is illustrated by the difficulty in estimating the source of a sound. When a person hears a

church bell ringing in an unknown locality, he is uncertain not only as to the direction but also as to the distance and volume. Is it a large bell ringing at a long distance, or a small bell ringing close by?

At one time some children at my house were playing a little game in which each child in turn was blindfolded and two coins were struck together about eighteen inches from the head. The children when blindfolded were almost totally unable to tell from what direction the sound came.

Helmholtz, sixty years ago, called attention to the hair on the organ of Corti and expressed his belief that their varying lengths might have to do with distinguishing tones. Little importance seems to have been attached to these hair endings. One is impressed with the modern radio and its antennae as a possible explanation of the hair endings of the organ of the sense of hearing as well as of the sense of smell, and the principles which underlie their function. One might say that these hairs are antennae acted on by electronic energy connected with changing air pressure which enables the individual to listen in, as the radio enthusiast would express it.

THE SENSE OF SIGHT

In the higher mammals, among which man is dominant, vision has secured direct pathways to the upper brain, and the sense of sight, giving comprehension of space, time and motion, has overborne the sense of smell. Pressure changes in the surroundings affect touch and hearing; changes in radiant energy affect the eyes. The mechanism of the human eye is in some respects inferior to that of the eye of some of the lower animals. With the telescopic vision of the eagle, man could read fine print at 500 feet.

Certain fishes in the depths of the sea radiate cold light, not necessarily connected with the eye, but emanating from specialized cells in various parts of the body, differing according to the habits and necessities of fish life, which makes possible a certain amount of vision. Cold light is also seen in

the glow-worm, the fire-fly and other animals. Much research is being carried on to determine the nature of this light, in the hope that it may be used instead of the hot light obtained by present-day methods of oxidation.

The eyes of many of the lower vertebrates have separate vision, and in only two diameters, length and breadth. The higher mammals, for instance man, with binocular vision, see in three diameters, length, breadth, and depth.

One hardly need call attention to the fact that it is not the mechanism of the eye of man which is triumphant, but its relation to the intelligence of man.

While the sense of sight is dominant among the special senses, owing to its accuracy, it is remarkable that those who lose this sense in infancy can, with training, substitute for it the senses of hearing and touch. Helen Keller is an example of an intelligence of high order developed largely from the sense of touch. We must remember, however, that in this training the teacher's sense of sight takes the place of that of the pupil. The intelligence is there, but it is not efficient until trained. The ear-trained and touch-trained blind man would not be so easily deceived in the dark by the faker as the eye-trained man suddenly placed in the dark, who would be more likely to be controlled by his ancient emotion of fear in the dark. Memory can be spoken of as mental photography.

The sight of man is not quick, and on this fact was based the old adage, "The hand is quicker than the eye." It must be borne in mind, however, that the hand in question is the hand of a prestidigitator educated by the eye.

VISION THE PREDOMINANT FACTOR IN THE EVOLUTION OF THE MEDICAL SCIENCES

In studying the history of medicine it is significant that in the 10,000 years of Egypt's history there were no less than eight complete relapses into barbarism, and there is little of value to scientific medicine in the meager records of those times.

Medicine began with the earliest peoples as an appeal to the emotions through occultism, and here originated the cults, which still abide with us. New cults come as the fraud of the old ones is exposed.

Scientific medicine had its beginning in the fourth century before the Christian era with Hippocrates, who founded clinical medicine, and with his near contemporary, Aristotle, who developed deductive reasoning and a primitive form of inductive logic, on which science rested securely for 2,000 years. The great school at Alexandria with its museum and library founded by the Ptolemies in the third century B.C., was the center of learning. Here the students of Aristotle developed and gave to the world the priceless gift of scientific methods. In the eleventh century Abelard founded scholastic education, in the thirteenth century the first university was established. In the sixteenth century Francis Bacon introduced into philosophy inductive reasoning. William Harvey, contemporary of Bacon, applied inductive reasoning to medicine and by experimentation established physiology on a sound basis. In this great Elizabethan or Shakespearean century came also the first of the physician-chemists, John Mayow, whose investigations led to the discovery of oxygen. In 1590, the Janssens brought out the microscope, an invention which was to revolutionize science. The present day microscopic limit is $1/10$ micron or $1/250,000$ of an inch.

The invention of the microscope increased the power of vision and made possible the epochal work of Pasteur which led to the popular recognition of the rôle of microorganisms in the causation of disease, with the result that the scourges of contagion, infection, and infectious diseases, which could be survived only by persons with natural or acquired immunity, have nearly disappeared. Scientific medicine has advanced more in the last fifty years through the extension of vision by means of the microscope than in all previous time. This is demonstrated by the illustrious work of Pasteur, Virchow,

Lister, Gorgas, and other eminent men of science who have created, so to speak, health and prolongation of life.

We see, as through a partially opened door, new gifts to man, through further extensions of vision into the submicroscopic field, which includes particles $1/1,000$ micron or $1/25,000,000$ inch in diameter. The romance and adventure of modern research lie in this ultramicroscopic realm.

In the years from 1803 to 1844 Dalton promulgated the atomic theory and investigated the constitution of the molecule, with so few instruments of precision that the exactness of his results bordered on the miraculous. As the result of the most extraordinary improvements in methods which are ultimately visual, knowledge has been gained of the field of the colloids as well as the molecule and the atom.

Sir William Bayliss has well said that there is no line of demarcation between physics and chemistry. In other words, it is only under certain physical conditions that those alterations in the atomic constitution of molecular bodies, which we speak of as chemical changes, take place.

The ray of light travels 186,000 miles a second. When the ray of light is refracted, as by colloid bodies, it is resolved into rays of various lengths and speeds which are recognized by the retina of the eye as colors. The longest ray appears as red, and in order of the length of the rays, orange, yellow, green, blue, and violet are seen. On the relative length of these rays the colorimetric system in medicine is based. With the x-ray the molecule and atom can be analyzed.

Photography plays a great part in fixing for deliberate study with the eye objects in rapid motion. One twelve-millionth of a second is sufficient to make a photograph which will show a bullet in flight at a muzzle velocity of 3,000 feet a second as though it were standing still.

A remarkable fact is that colloids, molecules, atoms, electrons and protons, unlike particulate substances which are microscopically visible, remain in rapid motion more or less permanently suspended in their medium in spite of the force

of gravity, although all are affected by pressure, temperature, and atmospheric conditions. Only under certain physical conditions can the electric exchange of electrons and protons in the atomic field of the molecule take place.

Moseley, Thompson, Bohr, Milliken, and other great men working in the field of pure science have developed methods of analysis which give new insight into the practice of medicine and have enabled a critical analysis of the functions of bodily organs. From colloidal chemistry there is now being built a new physiology of man and a better understanding of vital phenomena. Today, in certain instances, restoration of the sick can be as precisely accomplished in the living body as similar chemical changes in the test tube.

In the sixteenth century the average lifetime of man was twenty years. The microscope has given us knowledge of the cause, cure and prevention of disease, thereby increasing the average lifetime of man to fifty-eight years. Investigations of the ultramicroscopic field which we are now entering give promise of increasing the average lifetime to the scripture age of three score and ten.

SPLENECTOMY

ITS INDICATIONS AND TECHNIQUE

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THERE are few procedures in surgery which are girt about with such interesting problems as is the operation of splenectomy. The removal of an organ, the functions of which are not yet fully understood and the enlargements of which are beset by such intricate and varied blood dyscrasias, is in every case a fascinating experiment and offers a field for the most intimate cooperation between the surgeon and the hematologist. I do not propose in this paper to discuss the operation as carried out for traumatic rupture, for parasitic infections such as malaria or syphilis, or for the rare cysts and tumors which involve the organ. I shall limit myself to its use in splenomegaly associated with definite blood changes, and endeavor to define the indications for its successful employment in such cases.

Whilst splenic enlargement, and that often to a notable degree, is usually an important element in the case for splenectomy, it cannot be emphasized too strongly that it is the complete blood picture which is the decisive factor in the decision for or against the removal of the spleen in any given case. Thus in a case of marked anemia with gross splenic enlargement, if the bone marrow be not capable of throwing new red cells into the circulation, splenectomy will be ineffective, and, on the other hand, in purpura where blood platelets are deficient or absent, the removal of a relatively small and impalpable spleen may lead to a striking recovery. It behooves us, therefore, to define clearly what data, revealed by blood examination, are essential to a determination that splenectomy is a rational, and will be in all probability a successful procedure.

The introduction of the method of vital staining and the reticulocyte count have marked a striking advance in the selection of cases. If by the vital staining method the blood be shown to contain large numbers of reticulocytes or young red cells in the presence of well-marked anemia with splenic enlargement, we may safely argue that a competent bone marrow is doing its best to make good for excessive red cell destruction, and that in the latter process the large spleen is in all probability playing a leading part. If, therefore, we remove the spleen we may hope for a rapid rise in the red cell count and corresponding clinical improvement. If, on the other hand, the reticulocyte count is low and the anemia progressive, aplasia of the bone marrow is present and splenectomy offers little chance of bettering the patient's condition. A reticulocyte count should, therefore, be an essential preliminary to a decision regarding operation.

The platelet count is also of the first importance, not only in chronic purpura but in splenic anemia, for it is precisely in cases in which the platelet count is low that splenectomy offers most hope of success.

The three conditions in which splenectomy promises real relief are: splenic anemia, hemolytic jaundice and chronic purpura. I propose to illustrate by typical case records what we may hope to accomplish by surgery in these three diseases.

SPLENIC ANEMIA

It must be confessed at once that the cause of this disease is unknown. What we do know is, that associated with an anemia in which the red and white counts and the hemoglobin are all low, we have an enlargement of the spleen which reaches usually to somewhere between the costal margin and the umbilicus. The spleen is firm and has a rounded margin. Adhesions to the diaphragm are not the rule—in my experience are very rare unless infarction has occurred. The disease runs a very chronic course which is apt to be punctuated by hemorrhages from the stomach or, less commonly, the bowel. A high

portal blood pressure would appear to be the outstanding feature of the disease and accounts not only for the endophlebitic thickening which is sometimes encountered in the splenic vein, but also for the siderotic nodules met with throughout the spleen, these being the result of hemorrhages into the splenic pulp. Fibrotic changes in the liver are the usual accompaniment of the splenic changes and in old-standing cases the liver cirrhosis may dominate the picture and result in ascites and swelling of the lower limbs. We have as yet no proof that there is in the spleen any parasitic or toxic process which governs the pathological changes. We have, however, clinical proof that in a number of cases removal of the spleen is followed by a notable improvement in the blood picture and the clinical state of the patient.

The operation in this group of cases is not, as a rule, a difficult one. The spleen can usually be mobilized readily if the standard technique is followed, and the splenic vessels are, in my experience, not unduly fragile or brittle.

The following is a typical case:

CASE I. Mr. R. S., act. thirty-three, draftsman. *Complaint:* weakness, mental depression, breathlessness and hemorrhage from the bowel. *Duration:* four years.

Illness began insidiously with a feeling of weakness and loss of interest in his work, with occasional shivering attacks accompanied by slight jaundice. Two years ago he had a hemorrhage from the bowel and when examined he was found to have an enlarged spleen. The weakness got slowly but steadily more pronounced and two weeks ago he was admitted to the medical side of the hospital.

Examination: He was somewhat pale and was mentally depressed. The spleen was enlarged extending to within half an inch of the umbilicus. The liver was palpable just below the right costal margin. No free fluid in the abdomen.

Blood:

R.B.C.	3,700,000
W.B.C.	3,400
Hb.	70 per cent

No abnormal red cells, fragility normal.

A diagnosis of splenic anemia was made and operation recommended.

At operation numerous enlarged veins in the abdominal wall were encountered. The spleen was greatly enlarged with a mottled and pale surface and not adherent. Many large veins were seen in the gastrosplenic omentum and coursing over the splenic flexure of the colon. The liver had a morocco leather-like surface and showed early but definite cirrhosis. After mobilization the spleen was removed in the usual manner. It was noted that the splenic vein was friable from endophlebitis.

The immediate recovery was uneventful. His color improved and two weeks after operation the blood count was:

R.B.C.....	6,640,000
W.B.C.....	7,000
Hb.....	74 per cent

Pathological Report: Spleen weight 2 lbs. 3 $\frac{3}{4}$ oz. Marked thickening of capsule and fibrosis in stroma with siderotic nodules.

He returned to work two months later in good health and spirits and three years later reported well and with a normal blood count.

An interesting point now arose. He was eligible for promotion for a higher and pensionable post in the Civil Service but the Medical Board would not certify him as a fit man in view of the uncertainty of the ultimate prognosis and life expectancy in such cases. When consulted on the matter I agreed with their decision.

The ultimate prognosis is difficult to give with assurance. Whilst it may be said that with the removal of the spleen we have enhanced the patient's prospects of health and comfort very greatly, it cannot be asserted that we have cured him, and for life insurance purposes he will not be accepted as a first-class risk.

HEMOLYTIC JAUNDICE

In this disease, in which be it noted, jaundice is frequently by no means the outstanding feature, splenectomy is of proven value. Anemia is the characteristic feature and icterus is variable and often extremely faint. The absence of bile in the urine, its presence in the stools, a more or less profound anemia, the fragility of the red blood cells when tested with hypotonic saline, the positive indirect Van den Bergh reaction, the moderate enlargement of the spleen, and, most important of

all the presence of a large number of reticulocytes in the blood, indicate an active production of red cells which are perishing in great numbers.

Two types are usually described, the familial or congenital, and the acquired. Whilst the blood changes in each are essentially the same, in the acquired type the blood destruction is more massive and acute and the prognosis correspondingly more grave. It is sometimes a matter of some difficulty to decide in which of the two categories an individual case must be placed. From the practical point of view this is not of great significance as when the anemia and its associated disabilities threaten the patient's well-being and economic usefulness, and active treatment is called for, we know that splenectomy is of equal efficacy on both types. The fragile red cells fall a prey to the reticuloendothelial cells in the spleen and are destroyed in great numbers. The comforting demonstration of numerous reticulocytes in the blood gives us a confidence that removal of the spleen will permit of these young red cells reaching maturity and, further, we have some evidence to show that with the sacrifice of the spleen the fragility of the red cells is diminished although it does not disappear. The results of splenectomy are striking, lasting and most gratifying. The disappearance of the jaundice, the increase in the red cell count and hemoglobin, and the access in energy and well-being all proclaim the fact that the spleen was playing an active rôle in blood destruction.

The following is a typical case:

CASE II. Mrs. A. S., aet. forty-nine. For five years she had complained of intermittent attacks of epigastric pain not related to the taking of food. She also complained of flatulence and breathlessness. One year ago she became weak and more breathless and it was noted that her skin had a yellow tint. She was treated as a case of pernicious anemia with liver extract but without improvement. From time to time her weakness and breathlessness became aggravated and at such times she was definitely jaundiced. Some months ago she felt a lump in the left side of her abdomen. This has since increased in size. Latterly she has been confined to bed owing to increasing weakness.

Family History: No history of jaundice in parents or grandparents. One sister was said to have catarrhal jaundice and her son has had jaundice but proved negative to tests for hemolytic jaundice.

Examination: The patient was fairly deeply jaundiced. Urine bile free; stools colored. The spleen was enlarged to the level of the umbilicus with a firm, hard margin and readily palpable notch.

Blood Examination:

R.B.C.....	1,300,000
W.B.C.....	8,700
Hb.....	19 per cent
Reticulocytes.....	80 per cent
Platelets.....	201,000

Stained films showed many nucleated red cells, no poikilocytosis.

Fragility increased, .55, control .45

Van den Bergh Test. Direct positive, biphasic.

Indirect strong positive.

Icteric index, 25.

Coagulation time nine and one half-minutes.

A diagnosis of acquired acholuric jaundice was made and splenectomy recommended.

On the two nights preceding operation 5 c.c. of 10 per cent calcium chloride were given intravenously and during the induction of anesthesia 30 c.c. of 30 per cent sodium citrate were given intramuscularly.

Operation: Through a left paramedial incision a very large, non-adherent spleen was removed. The liver appeared normal. The gall bladder, which was full of gallstones, was left undisturbed. There was practically no hemorrhage and no transfusion was necessary. Following operation the patient developed bronchopneumonia, but in spite of this made a good recovery.

Figure 1 shows the blood changes following operation.

Pathological Report: Spleen weight 2 lbs. 2½ oz., dark in color, marked free iron reaction. Numerous granules of hemosiderin pigment visible. Pulp spaces intensely congested; large macrophages containing pigment.

Typical hemolytic jaundice in an active phase.

This case shows the value of the reticulocyte count in such conditions. The presence of nucleated red cells had led originally to a diagnosis of pernicious anemia but no individual could continue anemic with 80 per cent of reticulocytes unless gross red cell destruction was going on. It showed further that a

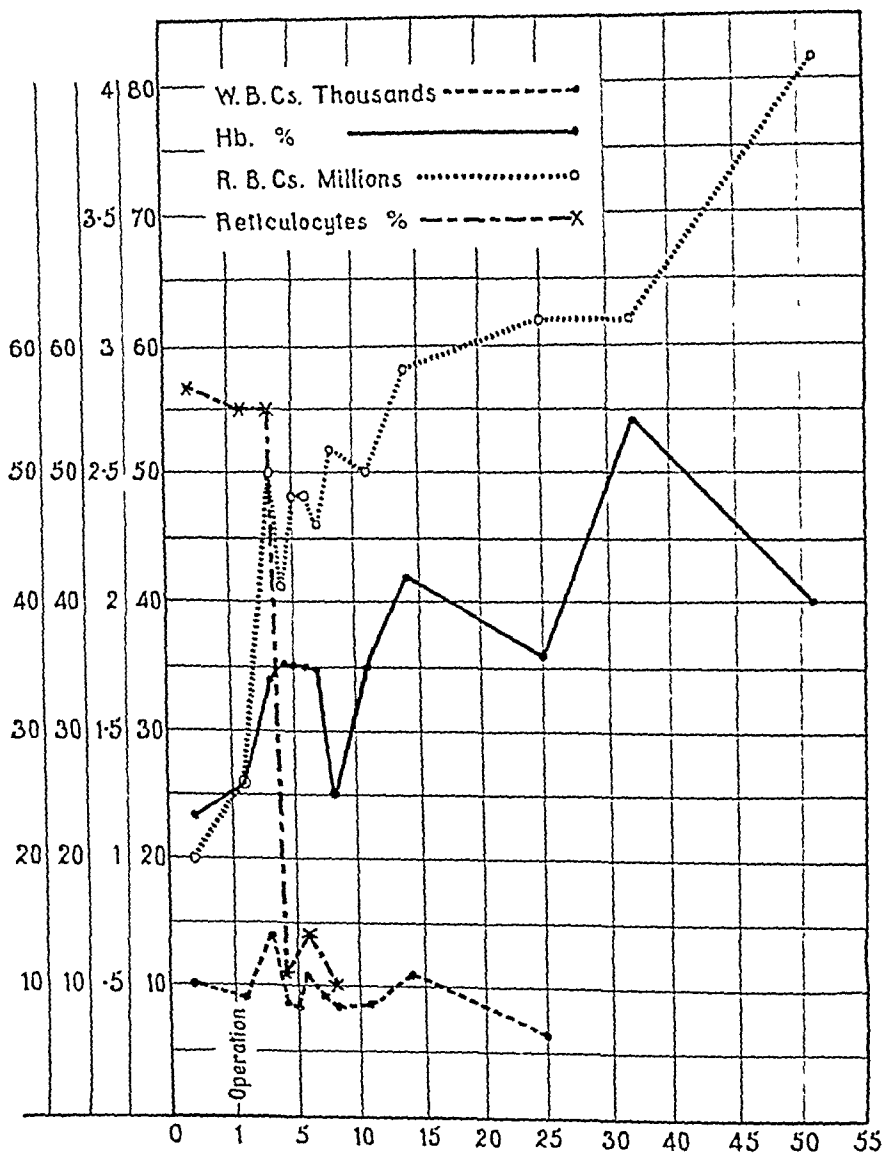


FIG. 1.

splenectomy must almost certainly be helpful. That the spleen was not alone responsible for the blood destruction, however, was shown by the fact that five weeks after operation there were still 6 per cent of reticulocytes in the red count.

CHRONIC PURPURA

Although the most recent addition to the list of diseases successfully treated by splenectomy, purpura offers perhaps the most striking results. Kaznelson in 1916 was the first to recommend the operation and in the past fourteen years some 200 cases have been recorded in which it has been carried out. At the outset emphasis must be laid on the fact that purpura is a symptom and not necessarily a disease. There is a clinical entity, however, which we term chronic purpura or purpura simplex, which is characterized by recurring hemorrhages into the skin and from the mucous surfaces, which, starting as a rule in childhood, recurs at intervals and may threaten life. The two factors which appear to be operative in determining the hemorrhages are a congenital weakness of the capillary wall and a marked diminution or absence of blood platelets. A prolonged bleeding time is always present but with this is a normal clotting time and a failure of the clot to retract. If a Bier's elastic bandage be applied to the arm multitudes of petechiae appear on the forearm and hand.

It is known that removal of the spleen always leads to an increase in the platelet count. Kaznelson, believing that in chronic purpura platelets were formed in normal numbers but were destroyed by over-active phagocytosis in the spleen, recommended splenectomy as the rational line of treatment. The results of the operation have amply fulfilled his prediction.

The following is a typical case of chronic purpura treated by splenectomy:

CASE III. Madge B., aet. fourteen. Since infancy patient has had a tendency to excessive bleeding on slight injury, e.g. when aged seven she had an abscess opened and continued to bleed from the small incision until her life was in danger and transfusion was necessary. Frequently there

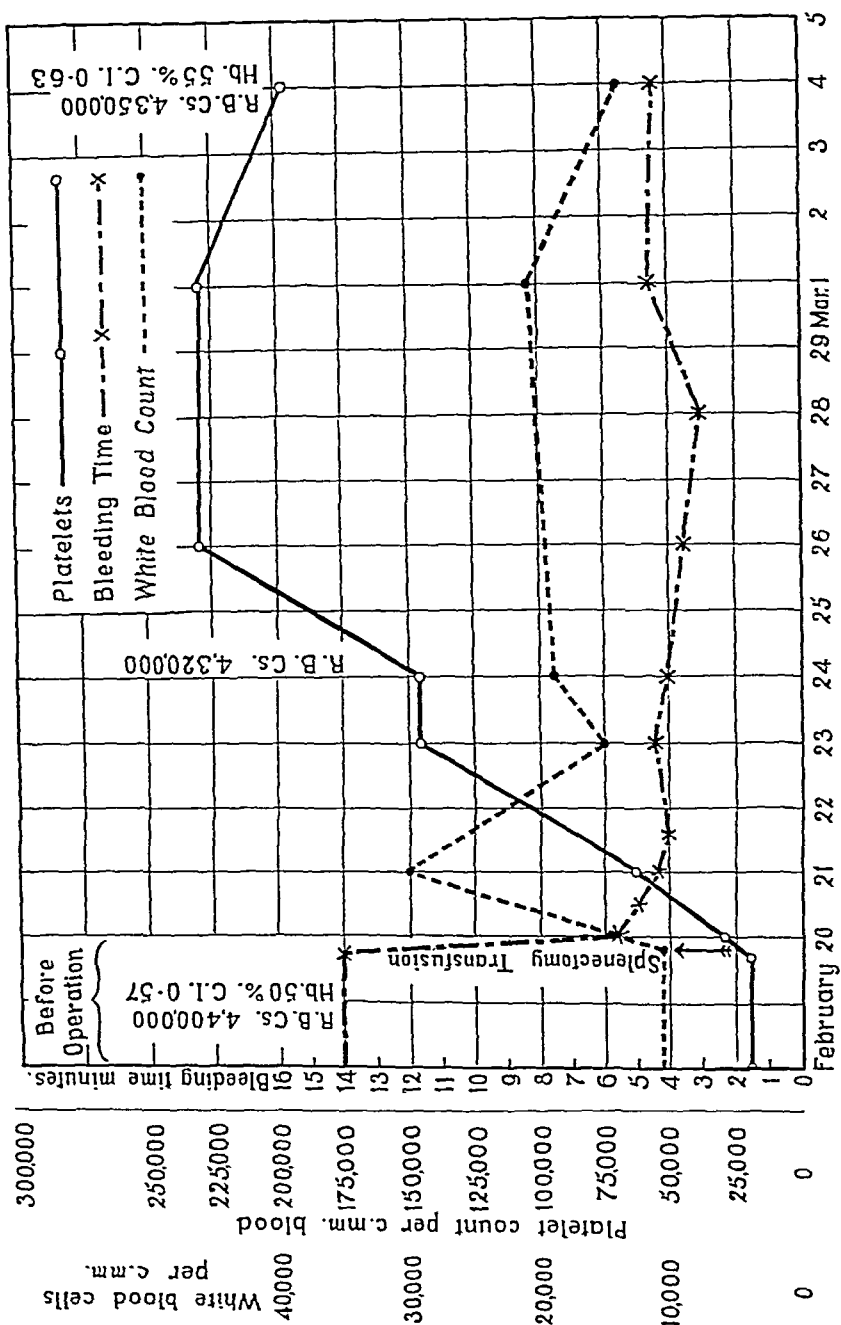


FIG. 2.

has been spontaneous bleeding from the nose and gums. Crops of purpuric spots have frequently been noticed. Her first menstrual period began on January 7, 1928. She continued to bleed, and was admitted to hospital thirteen days later exsanguine. The uterus was packed and bleeding arrested. No family history of purpura. Whilst recovering from the severe hemorrhage patient developed purpuric spots on the trunk and limbs. She was transferred to a surgical ward four weeks after the uterine hemorrhage. She was then pale but not grossly anemic. A few purpuric spots remained. The spleen was not palpable but the splenic dulness was slightly enlarged.

Blood Examination:

R.B.C.....	4,600,000
W.B.C.....	10,200
Hb.....	50 per cent
Platelets.....	18,000
Bleeding time.....	14 minutes
Coagulation time.....	3½ minutes
Fragility.....	normal
Film.....	typical of secondary anemia.

On applying a Bier's bandage round the upper arm innumerable purpuric spots appeared over the forearm and hand.

Diagnosis: Purpura simplex.

Operation was carried out on February 20, 1928. A spleen, slightly enlarged (weighing 3½ oz.) was removed and 400 c.c. citrated blood transfused.

Pathological Report: Spleen slightly enlarged. No notable pathological change visible.

Recovery rapid. A slight attack of tonsillitis caused a temporary leucocytosis. Figure 2 shows clearly the rapid rise in platelets and diminution of bleeding time.

Two weeks after operation a Bier's bandage applied to the arm produced no purpuric spots. Two years later patient reported in robust health. There had been no further bleeding, menstruation was normal and the tendency to bruising on slight injury had disappeared.

THE OPERATION

In textbooks of operative surgery no operation is described so inadequately as splenectomy. Whether the spleen be normal in size or grossly enlarged there are certain points in anatomy which must be appreciated if its surgical removal is to be

rendered easy and safe. The organ lies very deeply in the left hypochondrium and is maintained in position by the lienorenal ligament up to the medial border of which run the

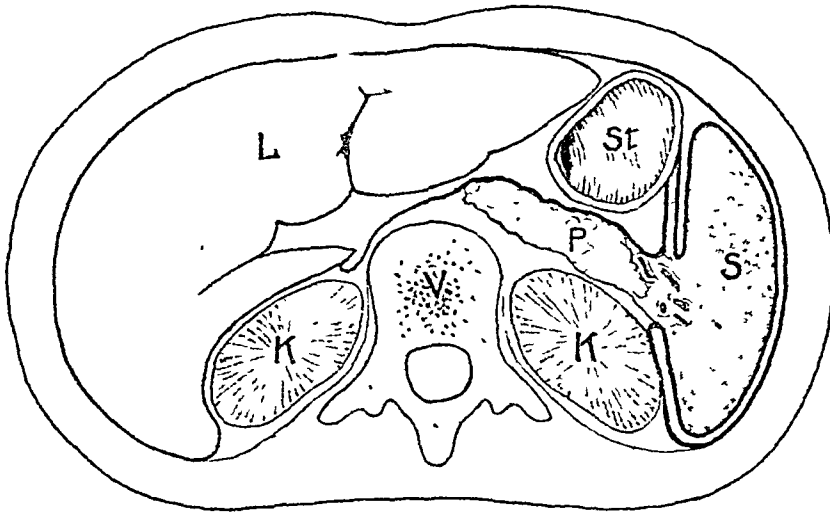


FIG. 3. Transverse section to show deep-seated position of the splenic pedicle and the necessity for division of outer leaf of the lienorenal ligament.

splenic vessels (Fig. 3). The outer leaf of this ligament is short and in splenomegaly is often thickened. It forms an effective barrier to delivery of the spleen into the wound and it must be divided as a definite step in the operation before any attempt is made to deal with the splenic pedicle. In order to expose the front of this pedicle the gastrosplenic omentum must be divided, the vasa brevia being ligated, and, that ready access to the pedicle in case of mishap may be ensured, this should be the first step of the operation (Fig. 4). The gastrosplenic omentum is very short at the upper pole of the spleen and care must here be exercised in ligating. It is of advantage to leave this short uppermost portion till a later stage in the operation when complete mobility of the spleen has been secured. That the stomach may not impede the view of the

splenic pedicle it is a good practice to pass a stomach tube and leave it *in situ* during the early stages of the operation.

Now comes the most important step in the operation. A

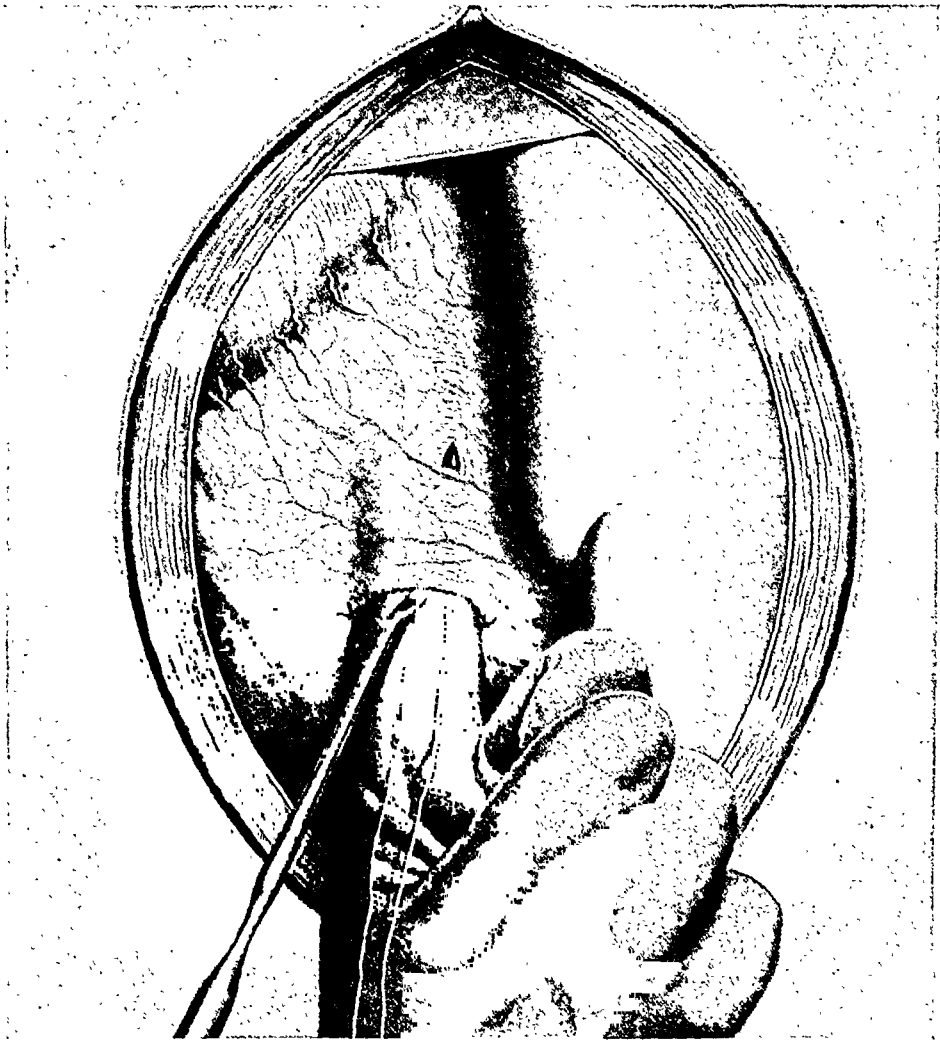


FIG. 4. Transfixion and ligation of gastrosplenic omentum.

hand is placed over the phrenic surface of the spleen and the organ is gently pulled over to the right. At the same time the left costal margin is retracted and the outer leaf of the lienorenal ligament, which has been rendered tense, is exposed. With a long-handled knife the peritoneum of the ligament is divided and the spleen comes forward (Fig. 5). With a second

touch of the knife the thickened subperitoneal areolar tissue or fascia propria is divided and the spleen completely mobilized (Fig. 6). No difficulty is now encountered in delivering the

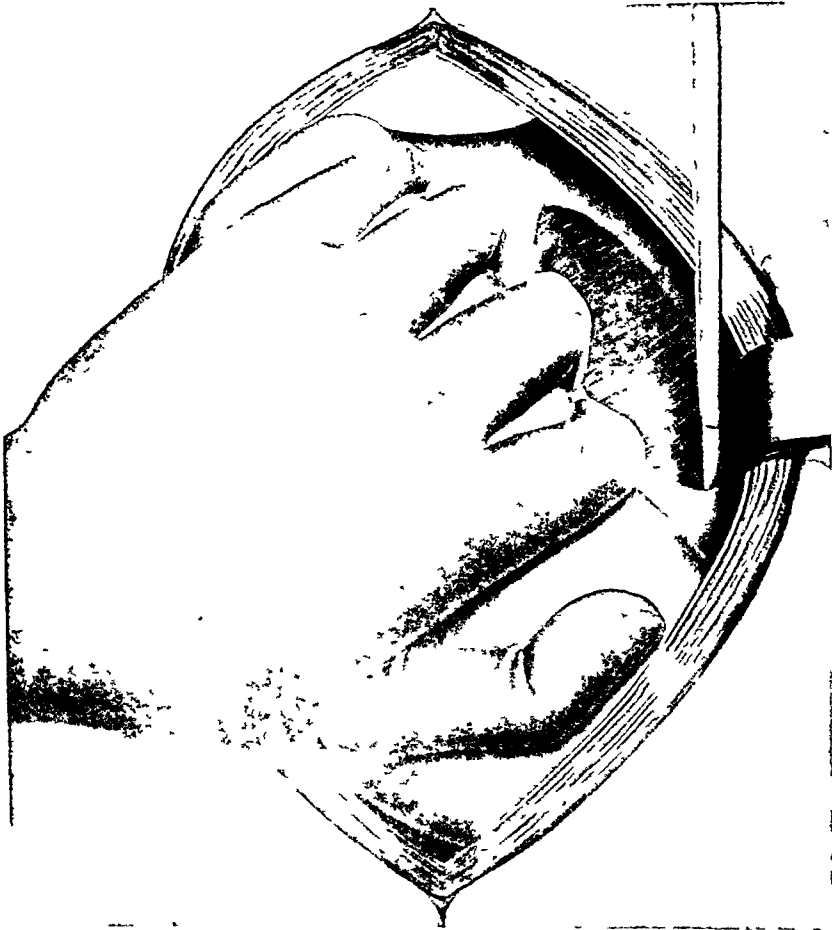


FIG 5 Division of peritoneum of outer leaf of lienorenal ligament.

spleen in the abdominal wound. The upper end of the gastrosplenic omentum is now readily accessible and the very short vessels running from the stomach to the upper part of the splenic hilum are ligated and divided (Fig. 7). The main splenic pedicle is now raised on two fingers of the left hand. The

splenic artery which lies uppermost is freed, doubly ligated and divided. After a pause to allow of venous drainage and thus minimize loss of blood, the splenic vein is similarly dealt with

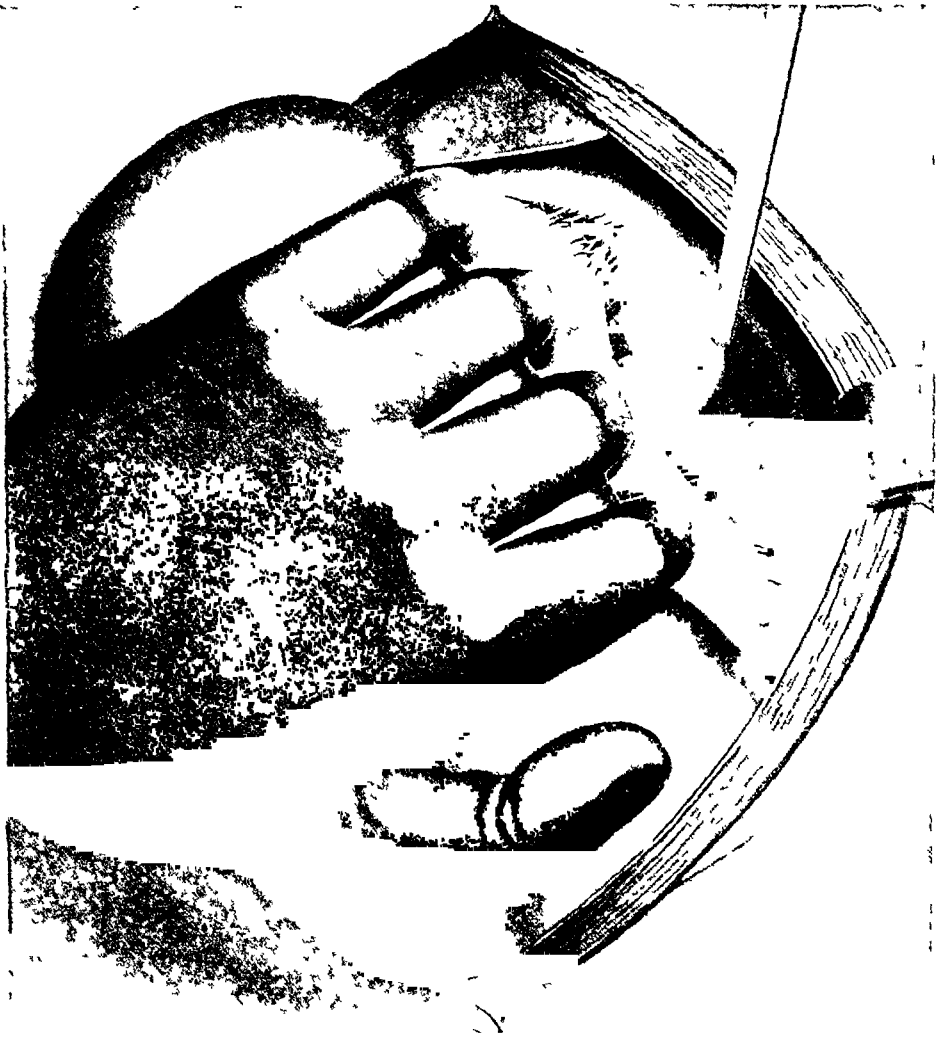


FIG. 6 Division of fascia propria of lienorenal ligament.

(Fig. 8). The tail of the pancreas can now be dissected off and the spleen removed. There should be no hemorrhage.

Summarized the steps of the operation are as follows:

1. Anesthesia.
2. Passage of stomach tube.

3. Left paramedian incision.
4. Ligation and division of the gastrosplenic omentum.
5. Spleen gently pulled to right and with a long knife the

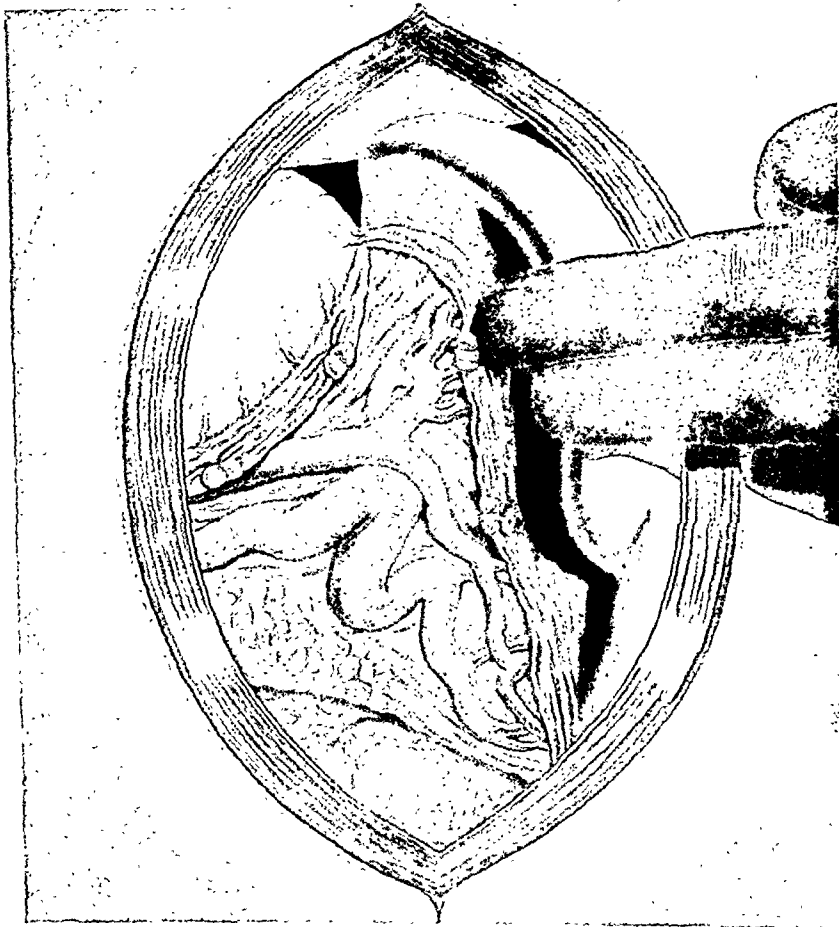


FIG. 7. Division of gastrosplenic omentum almost complete. Note close contiguity of stomach to upper pole of spleen and the free exposure of splenic pedicle.

peritoneum forming the outer leaf of the lienorenal ligament divided. The underlying fascia propria is also divided.

6. Spleen delivered in wound and extreme upper end of gastrosplenic omentum divided between ligatures.

7. Pedicle raised on fingers.

8. Splenic artery doubly ligated and divided.

9. Splenic vein doubly ligated and divided.
 10. Tail of pancreas dissected off.
- There is no abdominal operation in which a deliberate

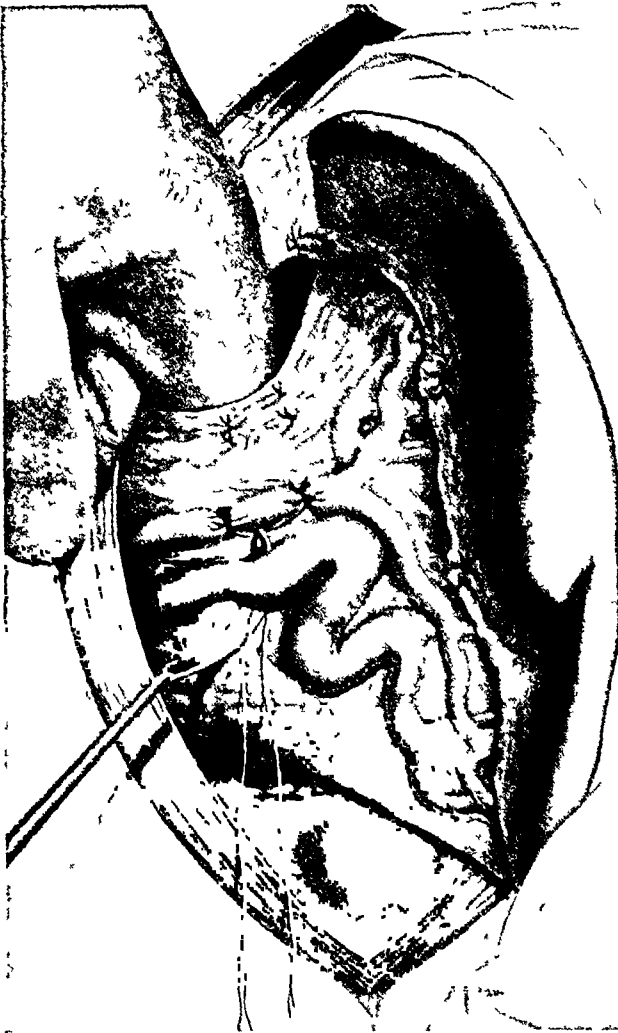


FIG. 8. Splenic artery doubly ligated. Ligature being passed round vein.

plan, based on anatomical knowledge, is more essential than in splenectomy. In dealing even with the largest spleen hemorrhage need not occur if such a plan be followed, and what some have called adhesions are, I believe, merely anatomical attachments thickened to support the weight of the enlarged organ. Speed is of no importance in the bad risk splenectomy; infinite care of preclude the possibility of hemorrhage is all-important.

OPERATIVE TREATMENT OF PHTHISIS

THE SURGEON'S MORAL OBLIGATION

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MANY years of clinical and laboratory observation have resulted in the general opinion that pulmonary tuberculosis¹ has a tendency toward recession and even toward permanent inactivity, provided the affected organ is placed at rest. This disposition to what we will call clinical cure is present in all stages of the disease but it varies in force with the degree of immunity which is encountered and this is never exactly the same in two individuals. Mixed infections and other complicating conditions, whether or not produced by the tuberculous process, will stand in the way of recovery, while the progress of a coincident fatal disease may terminate life before it would have been ended by the tuberculosis.

It is hardly necessary here to define the meaning of rest as employed in this discussion. Obviously it signifies not only absence of visible motion, but also as near an approach as possible to cessation of function. Rest of this type need not be permanent, however, and more or less function may be permitted to be reestablished according to the length of the rest period and the ability of the lung to behave normally.

The actual cure takes place by cicatrization with the obliteration of the spaces produced by destruction of tissue. There can be no absolute rest so long as pathological cavities exist in the lung. Complete drainage of these cavities is a necessary part of the rest in its fullest sense, whether produced by adhesion of their walls or by inspissation of their contents with calcification.

¹ Chronic ulcerative tuberculosis, as usually encountered, is the type referred to in this paper, not acute miliary or acute pneumonic tuberculosis.

With these few words let us assume that the main principles of the desiderata in the surgical therapy of tuberculosis are understood by the reader and that the question is that of the selection of patients and the sequence of operative procedure. I have mentioned the patient first because one must have a patient before he can operate. But since in making any important decision one should look into whatever choice of action there may be, I will reverse the order and give a short review of the surgical procedures at our command. Finally I shall analyze the question which is hinted at in the title of this paper, namely, in what cases has the surgeon the right to withhold the chance offered by operation.

METHODS OF SURGICAL ATTACK

1. INTERRUPTION OF PHRENIC INNERVATION. Yates, of Milwaukee,¹ has devised a means for temporarily reducing negative intrapleural pressure and for diminishing the size of the affected lung, by crushing the phrenic nerve through an incision in the neck.² The resulting diaphragmatic paralysis may be expected to persist for three months or more during which the patient is treated on hygienic principles and also by repeated small blood transfusions; for it is Yates' opinion that hyperemia is of value in combatting a tuberculous lesion. This method of treatment has its best application in early cases before fibrosis and cavitation have begun. The elevation of the diaphragm produced by the negative intrapleural tension and by the pressure of the abdominal viscera from below, takes away from the pleural cavity the equivalent of from 200 to 500 c.c. or more of air.

2. ARTIFICIAL PNEUMOTHORAX. The technical details of this method will not be described here. Its object is to increase the size of the pleural space and at first to collapse and eventually compress the affected lung, giving it more or less complete rest from both visible expansion and respiratory function.

¹ Yates, J. L. *Arch. Surg.*, 19: 1122-1160, 1929.

² Operation upon the phrenic nerve to reduce intrapleural negative tension is not new. (Stuertz. *Deutsche med. Wchnschr.*, p. 2224, 1911.)

Small quantities of air are insufflated as a tentative measure and so-called low tension pneumothorax is produced. The less diseased or the healthy parts of the lung may then function while the infiltrated portion remains immobile. This is called the selective action of low tension pneumothorax but in reality, of course, it is not a selective action, for the diseased part of the lung is not truly compressed.

In most cases in which treatment by pneumothorax is applied cavitation with fibrosis is present, whether the case is one of months or of years in duration. In certain cavities with collapsible walls a complete obliteration may be produced and when, after months or a year or more the lung is again permitted to expand, the cavity will have been replaced by scar tissue and a true arrest of the tuberculous process may have occurred. Treatment by pneumothorax is less applicable when there is solidification of the lung but even here it may be of some value.

The liability to hemoptysis is greatly reduced by intrapleural pneumatic compression and even active hemorrhage may promptly cease.

The principal difficulty in producing pneumothorax, one which often prevents the use of this agent, is adhesion between lung and parietal pleura. If these adhesions are soft gradual increase in air tension may break them down; or certain string-like connections between lung and chest wall may be divided according to a plan devised by Jacobaeus with the use of an instrument which is inserted into the chest cavity between the ribs and which permits visual exploration as well as the division of adhesions.

The dangers of therapeutic pneumothorax are, briefly, hemorrhage from the chest wall or from an accidental injury to a visceral vessel; cerebral air embolism if the patient is treated, wrongly, in the upright position; and the production of pyopneumothorax with mixed infection. If this form of pyopneumothorax cannot be controlled by evacuation and antiseptic washing through a needle or cannula, open drainage

may be necessary, but this frequently means that other operations for the obliteration of the infected pleural cavity must be performed.

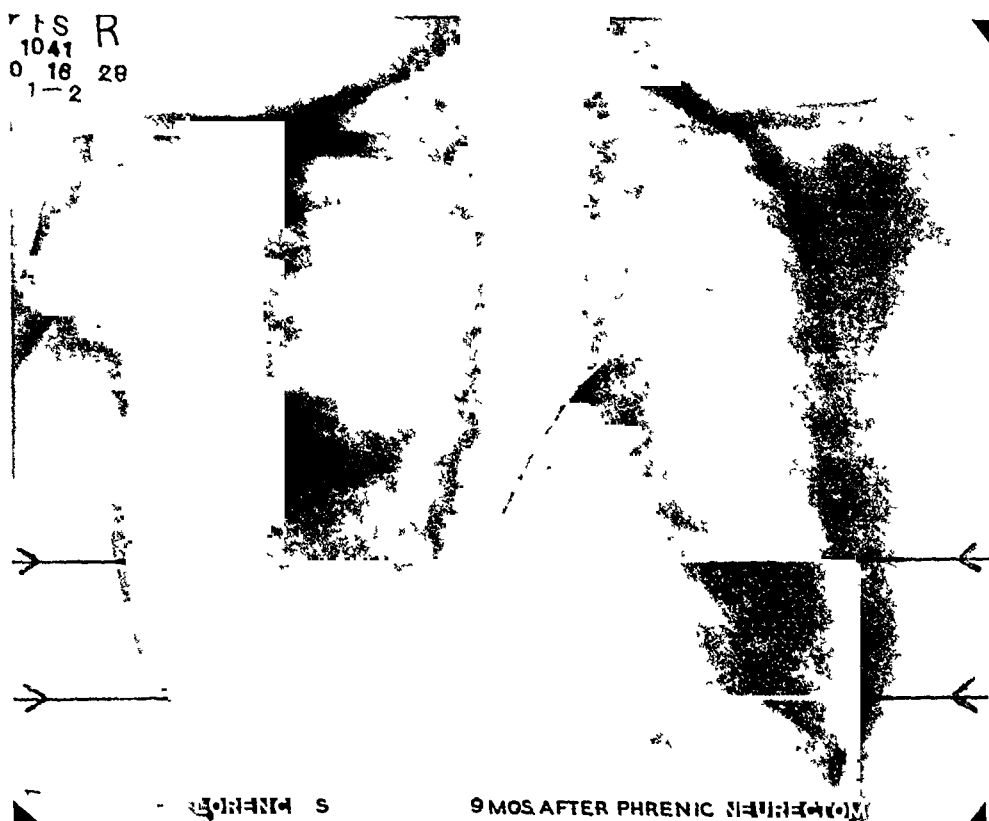


FIG. 1. Suppurative bronchiectasis. Showing elevation of right diaphragm nine months following phrenic neurectomy. Horizontal lines mark level of diaphragmatic domes. Compare with Figure 2.

In deciding upon the sequence of treatment between pneumothorax and phrenic nerve interruption it must be remembered that the latter procedure renders the diaphragmatic muscle flaccid and that therefore it should never precede artificial pneumothorax. The powerless diaphragm will be merely pushed down by the increasing air pressure within the chest. Observe Figure 1, not, by the way, a case of tuberculosis but one of suppurative bronchiectasis of the lower lobe. In this picture we see the result of a phrenic neurectomy which has elevated the right diaphragm and has partly compressed

the bronchiectasis. After this operation there was but little improvement and it was my intention to extirpate the pulmonary lobe but the patient refused and I referred her to Dr.



FIG. 2. Same case as Figure 1. Because of adhesions artificial pneumothorax is confined to the upper half of the chest. There is but slight collapse of the bronchiectatic lung and the flaccid diaphragm has been forced down to its preoperative or normal position. Horizontal lines mark level of diaphragmatic domes.

Harry Wessler for treatment by pneumothorax. Adhesions prevented the complete collapse of the lung and unfortunately only the upper healthy portion was compressed by air. At the same time it is interesting to note in Figure 2 that the diaphragm has been pushed down to the normal preoperative position.

3. THORACOPLASTY. *Paravertebral Thoracoplasty*. This operation is an improvement by Ferdinand Sauerbruch on the methods of others to bring about permanent compression of the lung with obliteration of pathological cavities.

More than one hundred years ago the idea of surgery as a treatment for tuberculosis was in the mind of Sir James Car-

son¹ but to Brauer belongs the credit for deliberately advising surgical collapse of the chest. This was in 1906. It was Sauerbruch, however, who reasoned that resection or the mere division of the ribs close to the spine would cause them to be drawn downward and inward; not only by the constant though slight suction within the chest but also by contraction of the muscles of the trunk. At present this operation has become the best known and, on the whole, the most successful one in all the surgery of phthisis, although often enough it may become merely the first of a series. If the compression is not as complete as would be necessary to obliterate the pulmonary air spaces whether pathological or normal, supplementary operations are required and these will be catalogued farther on.

Paravertebral thoracoplasty may be performed in one stage or in several, but if serial operation is the choice the first attack should be upon the upper part of the thoracic cage including the first rib and as many below it as seems wise according to the patient's general condition. The ribs below those divided at the first stage should be resected either in one or two more stages as soon as the patient has recovered from the immediate shock and depression of the first seance. If too much time is permitted to intervene between operations, union by callus of the ribs already divided may interfere with the degree of compression in the upper chest which we might have expected from the number and length of the bone sections which were taken. There is usually less shock and less danger, however, from the operation upon the first five or six ribs than from those below because the amplitude of respiratory motion is much greater in the lower half of the chest and putting this lower part out of commission causes far greater physiological disturbance than that which follows the upper operation. All these rib resections should be performed subperiosteally for, if the covering is removed along with the bone, union will either not take place at all or will be so deferred that persistent free mobility of the bony chest wall will prevent

¹ Essays, Physiological and Practical. F. B. Wright, Liverpool, 1822.

the very thing, namely, absolute rest, for which we have been striving.

Under no circumstances should an encircling dressing of any kind be applied, not even a single bandage or strip of adhesive plaster. All postoperative compression should be secured by some form of elastic material, taking its support not far across the midline, front and back. I have found the elastic adhesive plaster known as Elastikon to be of great value in the dressings following thoracoplasty. But even with this excellent material there may be dislocation of the mediastinal structures, including the heart, toward the opposite side with consequent respiratory and circulatory embarrassment. Cyanosis is the signal for the immediate reduction of compression over the side which was operated upon.

The presence of large cavities with free bronchial connection in the upper chest counteracts normal negative pressure and when the patient coughs after the operation such cavities are ballooned out by the pneumatic impulse from the opposite lung, thus contributing to the maintenance of the hollow instead of permitting it to collapse. The surgeon, as well as the physician or phthisiologist, should bear this in mind so that the deficient collapse may not be wrongly attributed to a fault in the operation. However, an immediate incomplete effect of this kind, while it may eventually necessitate further surgical procedure, need not be regarded as the ultimate result of the thoracoplasty since these cavities may gradually contract over several months or even a year and the mediastinum, deviating toward the more diseased side, and the physiological emphysema of the opposite lung may further aid in obliterating the cavity.

The tuberculous patient, even though he may be seriously ill, with high fever and with comparatively low blood pressure, will usually endure operative procedures astonishingly well and this fact is seldom recognized by the physician in charge. To be sure there is a sharp reaction for a few days, probably because of the absorption of toxins resembling, in a measure,

the disturbance following an injection of tuberculin. After this, however, convalescence may be expected to proceed normally. The mortality rate in my own experience appears to



FIG. 3. Case vi. Large left upper lung cavity with pleural sacculated fluid level and pneumonic lower part of the lung. Right lung nearly normal.

depend largely upon what happens to the contralateral lung, for we have here in addition to the usual dangers following any thoracic operation, the added peril of the lighting-up of an old process. Because of this it is best to withhold operation until clinical and x-ray examination for at least two consecutive months have shown a static contralateral condition. (See Case vi, Figs. 3 and 4.)

If patients are carefully selected for surgery with regard only to statistics the death rate will doubtless be lower than would be the case if the weeding-out process had been given

less attention; but we shall miss the chance of restoring to health and usefulness many a one who would otherwise die an early death or whose only hope would be to linger on for a

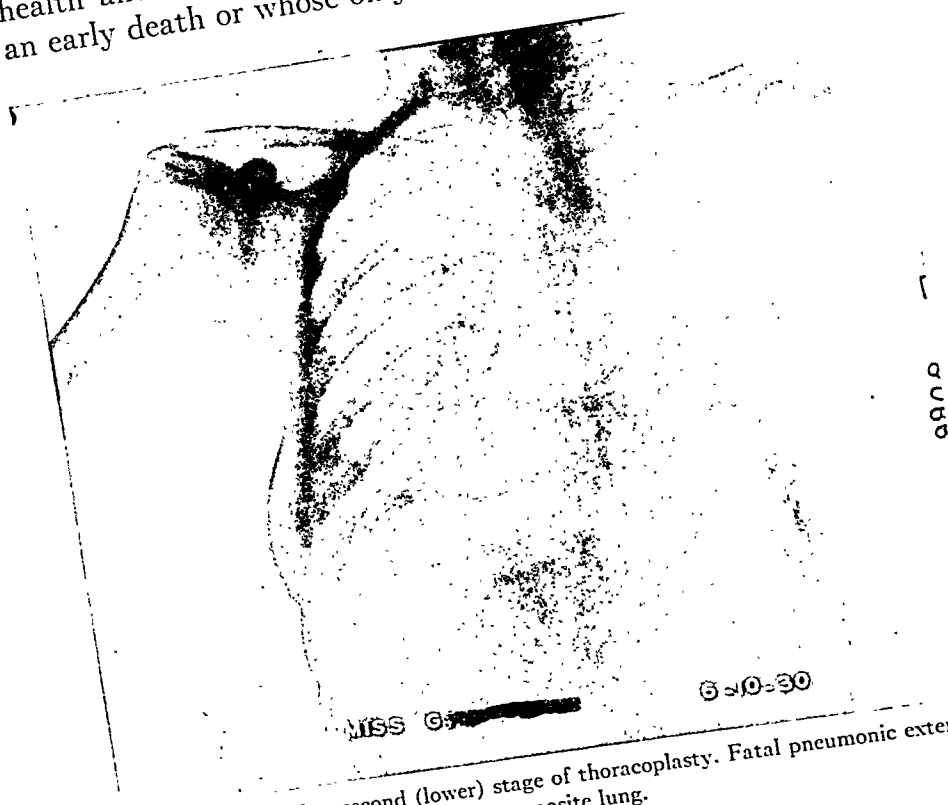


FIG. 4. Case vi after second (lower) stage of thoracoplasty. Fatal pneumonic extension to opposite lung.

space, a misery to himself and to those who love him. In the concluding part of the paper this phase will be taken up in greater detail.

Secondary Thoracoplasty. Should it be found, after the postoperative state has become well established, that compression is still inadequate, further rib resection, either through the old scar or along the axillary line or even on the front of the chest may be required in order to bring about further obliteration of the lung space. These operations are rarely as dangerous as that which the patient has already experienced. At all

costs if the disease is to be arrested good compression must be secured.

4. APICAL EXTRAPLEURAL COMPRESSION. When all seems to be well except for insufficient collapse of the thoracic dome a further procedure known as *apicolysis* or *superior extrapleural pneumonolysis* may be carried out. This consists in the subperiosteal resection of two or more of the upper ribs reached through an axillary incision with peeling away of the soft parts from the bones including, of course, the endothoracic fascia and pleura, from behind forward and from above downward so that the apex of the lung is finally replaced by a large extrapleural artificial space. This should be maintained in one way or another by some form of daily packing, and the chances are excellent that it will become permanently and rigidly obliterated, the skin dipping down to the bottom. Not until this has occurred can one be assured by the improvement in cough and expectoration that our goal has been reached. Even then, however, cavities, bronchiectatic or other, in the lower lobe of the lung may contribute to a continuance of the symptoms.

Apicolysis, though a delicate operation, is not a particularly dangerous one if I may judge from my own results, for I have not lost any tuberculous patient from this cause,* and have only lost one other case, that of an individual with acute abscess of the right upper lobe.

5. DIRECT DRAINAGE AND (6) MYOPLASTIC PLUGGING. Occasionally a tuberculous cavity becomes the seat of mixed infection, sometimes anaerobic in character. There is then a tendency to gangrene of lung tissue with consequent severe hemorrhage combined with a peculiar sepsis which this infection produces. It may then be necessary to perform actual drainage into the world as in acute progressive lung abscess. This will give quick relief but although thoracic fistulae of this type contract and may even close spontaneously,¹ yet

* Since this paper was sent for publication—about a year and a half ago—I have lost a patient following apicolysis. (H. L. Aug. 20, 1931.)

¹ Lilienthal, H. *Arch. Surg.*, 19: 1161-1168, 1929.

the tuberculous cavity itself remains patent. Applying the ingenious and original method of Pool and Garlock¹ a large pedicled flap of muscle, preferably from the paraspinal group, may be turned into the cavity with a reasonable chance that the plugging will be permanent. Pool and Garlock devised this procedure for non-tuberculous abscesses and I have completed the operation in only one case of tuberculosis. The result, so far as the obliteration of the cavity was concerned, was perfect; the patient, however, is suffering from tuberculous disease of other parts of the lung more than year after the myoplastic plugging.

It appears that muscle is not particularly susceptible to infection by Koch's bacillus.

In another case the incision for the original thoracoplasty had been made so close to the spine that these muscles could not be used and I employed the upper two-thirds of the latissimus dorsi which, however, was not of sufficient bulk to fill the great space in the lung, so the operation could not be completed. The result was only partially successful. The idea of Pool and Garlock is excellent and I am convinced that further experience with this procedure will make one less fearful of thoracotomy in the direct drainage of tuberculous cavities.

The operations which have been here listed and briefly described are intended to place the lung in such a condition that the natural recession of the pathological process may be unimpeded.²

7. PNEUMONECTOMY. For an absolute and not merely a clinical cure, it would be necessary to extirpate the diseased lung and this was actually carried out many years ago by Sir William Macewen. His success in some of these cases is a great tribute to the vision, skill and resourcefulness of this eminent man who, long before the standardization of thoracic surgery, was able to achieve such an amazing result. His

¹ Pool, E. H., and Garlock, J. H. *Ann. Surg.*, 90: 213-237, 1929.

² Very seldom progressive tuberculosis has been found in a surgically collapsed lung.

example, however, has not been followed and with the recognition that tuberculosis is, probably from the beginning, a general infection, the eradication of the disease by removing its principal seat is hardly possible.

EMPHYEMA

The complication of tuberculosis by mixed empyema is one which changes the entire aspect of the case as well as the plan of action. The accident may happen from the infection of the fluid so commonly seen during treatment by artificial pneumothorax or it may be brought about by the infection of a tuberculous pleural effusion. Rupture of a pulmonary cavity or its ulceration into the pleural space is the commonest cause of spontaneous pyopneumothorax and there is then always a pleurobronchial fistula although it may be of small size. Gas may, however, be generated by certain of the infecting bacteria without bronchial connection. At any rate, the addition of empyema to tuberculosis is a serious thing and brings with it the difficult problem of obliterating the pleural space with as little expansion of the lung as possible, at the same time permanently closing the fistulae both bronchopleural and external. Tension within a closed pneumothorax of this type usually results from a valve-like action of the bronchopleural opening which permits air to enter the pleura but blocks its exit through the natural passages. This extremely dangerous condition becomes a veritable emergency and must be treated by some form of thoracotomy or paracentesis so that the hypertension is greatly reduced or is made to disappear. The fluid in an empyema not accompanied by tense pneumothorax should be examined microscopically and by culture to identify the pathogenic organisms, for in many instances contaminating bacteria may be eliminated, as stated before, by washing and disinfection through a needle without an incision into the pleura (Figs. 5 to 8). When accompanied by tense pneumothorax, however, aspiration affords only temporary relief and thoracotomy must be performed, with or without rib resec-



FIG. 5.

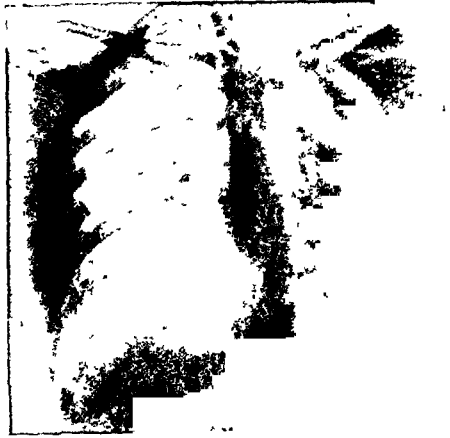


FIG. 6.

FIG. 5. Elizabeth R. Phthisis. Pyopneumothorax. Culture from fluid yielded pneumococcus type 3. (From *Ann. Surg.*)

FIG. 6. Same case as Figure 5, but after thoracoplasty. Fluid absorbed following repeated aspiration and disinfection. No thoracotomy. The air and fluid present at the time of thoracoplasty prevented full collapse. (From *Ann. Surg.*)



FIG. 7.



FIG. 8.

FIGS. 7 and 8. Photographs of Elizabeth R. After healing. (From *Ann. Surg.*)

tion. In most of these cases it will be found that the empyema has effectively compressed the lung and if, for the reasons just given, open drainage is unavoidable the procedure should be planned so as to maintain this pulmonary collapse. Almost invariably there is great difficulty in bringing about the healing of the bronchial fistula, and while it is most desirable that these openings should be closed yet life may go on in comparative safety and comfort even with a permanent bronchial stoma through a thoracic fistula (See Case ix).

Reduction in the size of the infected pleural space may be gained by various forms of thoracoplasty. The patient may now have the deciding vote on the question of further operation to close the chest after the risks and advantages have been fully explained to him. The persuasion of the surgeon, which would be justifiable in the consideration of procedures looking toward the arrest of the tuberculosis, is not called for here.

ABOUT STATISTICS

To deny the value and importance of statistical study would be absurd. In business and in finance it is necessary, and in pure science it is essential. The great tables of the Life Insurance Companies have established an enormous mass of detailed facts which are of benefit both to the companies themselves and to the public. In a more remote way they exert an influence for good upon us all, prolonging life and minimizing the incidence of illness. But medicine, including surgery, is far from being a science. In spite of all our endeavor to make it so we find that after all it is the head and the hand of the doctor himself which determine the fate of the patient, regardless of mathematics.

Viewing medicine from its scientific angle there can be no objection to the publication of tabulated records, whether individual or collected; but, however valuable such records may be in the abstract, their importance regarding the single case in hand should not be overestimated. In calculating the

results of treatment in such a disease as tuberculosis of the lungs we come upon the inescapable separate nature of every case and of every patient. In arriving at a decision of importance, such as whether or not to operate, we must deal with the person before us; and no one better than the patient himself will appreciate this. Therefore, while it is good to have a knowledge of mathematical probabilities, the surgeon who has this too strongly fixed in his mind will lose the perspective of his own experience. Before he operates upon his first tuberculosis patient he should have had the opportunity of observing the work of others and of assisting at the wound often enough to have familiarized himself with the technique. As his own experience grows he will form impressions and he will be in a position to decide individual questions on their merits. No patient is interested in statistics of mortality unless he thinks that he himself will not be among the missing. It is sufficient that his phthisiologist assures him that so far as medical help alone goes, cure is not possible, but that with the aid of successful surgery conditions for further treatment will be improved. He must, however, return to the sanatorium or to the care of his physician when the wound is healed.

There are variations in the conditions surrounding the operation so that the only fair thing to do is to advise for or against after a most conscientious review of the progress of the illness from its beginning. The final question arises as to the ethics of submitting a person to an ordeal which may, on the one hand, shorten his life or which, if successful, may cure him. I maintain that the only thing which must, at all costs, be avoided is a procedure which might leave the patient in a state more intolerable than before.

For those who have recovered, even though they may represent but a small percentage, life has begun all over again. The families of those who died should feel a sense of relief instead of sorrow, that the intolerable and hopeless misery is at an end. Only the surgeon who lays too great stress on statistics will perhaps disapprove.

RESULTS FOLLOWING OPERATION

A patient may be cured, improved, unimproved, worse, or dead. And at once we run upon that dreaded word in all statistics, *Definition*.

What is meant by cure? Even the so-called clinical cure, after recovery from the operative treatment of tuberculosis? This is indeed difficult to answer. For example, a reporter may regard as successful any result in which the patient is alive after a specified period, let us say three months, six months, one year. But it is obvious that a "permanent cure" of tuberculosis is in the same category with the definition of a "happy" individual by Solon, the Greek philosopher, and that not until the patient is dead can one be sure that the old enemy will never again rise up against him. Therefore, when surgery has accomplished an arrest of the active disease so that the patient feels that he is well, there should still be no relaxation of care and watchfulness throughout his entire remaining life. And this brings us to the discussion of what is meant by success in the surgical treatment of phthisis.

The absurdity of accurate conclusions from statistics in pulmonary phthisis may be easily demonstrated by two hypothetical cases. Let us say that a certain reporter has chosen six months as his statistical period and that any patient living at the end of that time will be counted as exemplifying a successful case—not to say a cure. Now, he has operated upon John Doe and John has progressed satisfactorily throughout the half-year's period following the last procedure. He has gained in weight; his cough and expectoration have left him; his temperature is normal. On the day following the six months' period he dies of hemoptysis! . . . Next comes the case of Richard Roe who steadily deteriorates, not because of his operations, let us say, but in spite of them. His phthisis continues to advance, uninfluenced by the treatment and at the end of six months he is still alive, though sinking. According to the strict reading of statistics both cases should go on the

list of operative cures, though their progress was quite different and neither operation was successful. It all depends, in the last analysis, upon the surgeon's individual manner of estimating his results.

Figuring out the possibilities of success or failure from the charts of others is useful in proportion to the degree of one's intimate acquaintance with the reporter, and the knowledge of his methods of compilation. It will confuse the issue if we eliminate from the mortality list certain cases in which death cannot be proved to have been the outcome of the surgical procedure *alone*, unless the details in every case are analyzed; clearly a task which could only be accomplished with the aid of the surgeon submitting the table, and even then with the chance of error because of differences of interpretation.

Let us assume that soon after a thoracic operation upon a tuberculous patient a fatal hemorrhage closes the scene. Who can say, even after the post-mortem examination, whether the bleeding was produced by the operation or whether it was a terminating accident of the disease? And with other mishaps the same—a perforation with tense pneumothorax; cerebral embolism; sudden cardiac failure, etc. Those surgeons who lean over backward and regard all postoperative deaths *in the hospital* as the result of operation, are equally inaccurate but their statistics are of real value in comparing one of their own periods of time or one of their numerical group-units with another. I am speaking here particularly of pulmonary phthisis and not of other conditions.

In the April 1930 number of *Western Medicine*, published in San Francisco, there is a paper by H. E. Schiffbauer which is well worth reading and digesting. The title is Indication for Surgery in Pulmonary Tuberculosis. For the very reason that I believe this to be an important contribution and that it will have a wide influence I wish to differ here with the author in what seems to me to be a vital point. Schiffbauer says that: "Results from operation on improperly selected cases will be unfavorable and a discredit to surgery." Among his contra-

indications I will mention but three. The first is the question of "resistance to surgery." Now this is something which it is impossible to know until the test is made. Among medical men and even among phthisiologists there is a general feeling that their patients are particularly ill-suited to withstand an operation. In reply, I will say that from a considerable and long practice in general surgery and in its thoracic branch the tuberculous patient is fully as good a subject as the average non-tuberculous one of about the same degree of illness, as measured by nutrition, blood picture, abnormalities of temperature and cardiovascular sufficiency. I agree with Dr. Schiffbauer that myocardial degeneration should contraindicate any surgery except that of dire emergency. But "kidney impairment," unless it be a progressive nephritis, may disappear with the clinical cure of the pulmonary trouble. (See Case III.)

"Discredit to surgery" is the main point on which I take issue in the hope that I may allay in a measure the fear of a high mortality rate among patients who have been regarded by careful observers of wide experience as doomed.

I will admit that there are some conditions either of the tuberculous disease itself or of coexistent pathological processes which definitely forbid a resort to radical surgery and instead of making a detailed list of these, I will present here a table of broad scope leaving the finer differences to be determined by the reader.

The Tuberculous Infection

1. The contralateral lung so far destroyed that without its fellow it cannot be expected to exert a life-supporting function.
2. Other essential organs of the body broken down beyond repair.
3. Progressive cerebral lesions.

Tuberculous lesions affecting the larynx, the kidneys, the intestinal tract or other organs should not prevent the employment of operative surgery in the effort to clear the pulmonary

condition. Often the successful accomplishment of this result will improve resistance and may promote general convalescence.

Disease Other than Tuberculosis

1. Advancing cardiovascular disease.
2. Progressive nephritis.
3. Other essential organs destroyed beyond repair.
4. Malignant neoplasms not safely operable.

On the other hand, disorders of metabolism, such as diabetes, do not *per se* prohibit operative treatment and in other complicating so-called general disease the question will require individual decision.

Manifestly, if contraindications can be eliminated the question of operation, at first refused, may be reconsidered.

CASE HISTORIES

There can be no better way to indicate my attitude in this most important question than by submitting clinical examples. Let me select, then, from the entire list of my patients, ten who appeared to be almost or even quite beyond hope and who seemed to have but a few days, weeks or, at the most, months to live. In none of these cases did I urge or even suggest operation, but in none did I refuse, except in that of Case III in which I at first refused, then, some weeks later, when the patient's plight was even worse, finally consented; and complete arrest was the reward.

The histories, presented in brief résumé follow:

CASE I. *Progressive lesions with serious complications.*

Mr. F. G., aged thirty-one, had right sided upper pulmonary fibrocavernous tuberculosis, his illness having lasted for at least three years. There were physical signs in the opposite lung as well, but x-ray examination revealed nothing of grave import on that side. When I first saw him he was expectorating 16 oz. of mucopus. He had a tuberculous laryngitis; albumin and casts in the urine; frequent hemoptyses and a diarrhea clearly indicating intestinal lesions. It looked as if he could not live more than one or two months.

In 1924 I avulsed his right phrenic nerve and then performed a thoracoplasty of the first six ribs. There was improvement but the expectoration continued and two years later I did a right apicolysis after which he made a really beautiful recovery and was discharged from Loomis Sanatorium as an apparently arrested case, although there was slight non-bacillary sputum. Kidneys, intestines and larynx well.

This case exemplifies a type which might, on very good grounds, have been refused operation. Dr. J. Burns Amberson, who had referred him to me, rightly believed that there was nothing to be lost by operation and nothing to be gained by any other form of treatment. Unfortunately there are too many physicians and some surgeons who would have taken the opposite stand.

CASE II. *Massive hemorrhages. Tuberculous diarrhea, etc.*

Mrs. E. F., aged twenty-nine, had been ill for more than two years. There was a large right-sided cavity extending from the apex to the fourth interspace and there were many smaller ones below. The opposite lung was not appreciably diseased. The patient had laryngitis, tuberculous otitis media, diarrhea and severe hemoptyses. There were also albumin and casts in the urine. She was operated upon in 1924 and died a little less than a year later of nephritis with great edema and tuberculous enteritis.

CASE III. *Bilateral tuberculosis with multiple and grave complications.*

Mr. H. F. H., aged thirty-five, had been ill for many years. The principal lesion was a large apical cavity. The opposite lung was considerably diseased but for a few months the lesions had not progressed. There were double tuberculous otitis media, enteritis, nephrosis with great edema of the legs and cicatrized laryngeal tuberculosis. The outlook was so bad that at first I believed the case to be inoperable. Some months later, in Dec. 1928, Dr. Amberson urged me to give this man such benefit as might be remotely possible with surgery and I operated. His family were emphatically told that the prognosis was extremely bad. After thoracoplasty improvement began and Mr. H. was discharged in less than two years, clinically well, an arrested case. His nephrosis had disappeared. There was no fever. The slight morning expectoration was persistently free from bacilli. He went back into the world under normal living conditions.¹

CASE IV. *Hemoptysis the urgent reason for operation.*

Mr. J. M. E., aged twenty-eight had been ill for four years with general left fibrocavernous changes and with comparatively little disease in the

¹ As stated before, all these patients are expected to be ever watchful.

right lung. In March 1926 there came a series of rapidly recurring hemorrhages which appeared to be immediately threatening to life. He entered the hospital directly from the ambulance and was operated upon by thoracoplasty as the most certain method of securing prompt collapse. As in all my other patients pneumothorax had been unsuccessfully tested. The hemorrhage at once ceased and great improvement followed. The patient, however, "is still taking the cure."

CASE V. *Fibrocavernous tuberculosis with complicating hyperthyroidism.*

Mr. J. B., aged thirty-three, had bilateral tuberculosis with a quiescent lesion on the right side, infraclavicular, and with extensive fibrocavernous disease on the left. He had been operated upon some years before for exophthalmic goiter and his pulse was still rapid; there was tremor and also slight exophthalmos. X-ray pictures (Dr. William Snow) revealed the presence of a large cavity and several small ones in the upper left chest, with general fibrosis. On the right side there were scattered conglomerate infraclavicular tubercles. The reading was later confirmed at another x-ray examination by Dr. Leopold Jaches. I was assured by the phthisiologist in the case, however, that the right lung had not changed for more than two months. Thoracoplasty was done in January 1930 in two stages with much improvement both in cough and in the quantity of expectoration (still, however, bacillary) and, to my great gratification, in the disappearance of the tremor and abnormality of the pulse. This patient is now taking moderate exercise and is, I believe, convalescing although, if the expectoration does not disappear and the main cavity is not obliterated, an apicolysis may be necessary.

CASE VI. *Extensive left fibrocavernous disease with tense pneumothorax and dyspnea.*

Miss E. G., aged twenty-five, had been ill for eight years. The right lung, according to physical signs and x-ray examination appeared healthy. On the left there was extensive destruction and suddenly there appeared dyspnea and high fever. She was then referred to me by Dr. Joseph R. Morrow of Bergen Pines Sanatorium and I operated as in an emergency, resecting one rib and entering the pleural cavity. There was sacculated air under pressure but very little fluid and the lung felt solid to the touch. This was in April 1930. I waited for nearly two weeks for improvement to occur but the patient was rapidly losing ground and still dyspneic with respirations as high as 48. I then performed an upper stage thoracoplasty, six ribs, with great immediate improvement. Ten days later the five lower ribs were resected but soon afterward the opposite lung became acutely and extensively infected and the patient died. (Figs. 3 and 4.) I do not know how this could have been avoided. Because of the quantity of

sputum most of the operation was done with local anesthesia. Only a few whiffs of nitrous oxide were given for analgesia, which did not abolish the cough reflex. Figure 4 shows what happened. As I have stated before



FIG. 9. Case VIII. See text. Partial outline of empyema cavity after several operations. (Lipiodol.) (From *Ann. Surg.*)

this is one of the most frequent fatal complications following any operation in the treatment of phthisis.

CASE VII. *Left fibrocavernous disease with pyopneumothorax, not tense.*

Dr. L. M., aged forty, had been ill for more than one and one-half years. He was sent to me almost in extremis; the temperature 104°F. ; two recent attacks of cardiac irregularity; tuberculous enteritis. General condition extremely bad. At the earnest request of the patient's family, I began what was to have been a series of operations, by avulsing the left phrenic nerve; then evacuating fetid gas by trocar and cannula. The patient was delirious and in desperate straits. I hoped to tide over the acute stage by emptying the chest and that phrenic interruption would lessen the septic absorption. The man died in spite of all that was done, not because of it. His case is mentioned here merely to show that I have not refused even the slightest chance to improve an apparently hopeless case.

CASE VIII. *Illustrating tuberculous empyema with septic mixed infection.*

Mr. A. L., aged twenty-four, had been ill for two years and the lesions were principally in the right chest. There was spontaneous pneumothorax. When I saw him in February 1926 he might have been called moribund

with little, exaggeration. The temperature was 104°F., respirations 38 and labored. His condition was so poor that his uncle, an experienced physician, advised against any operation fearing that he would not survive

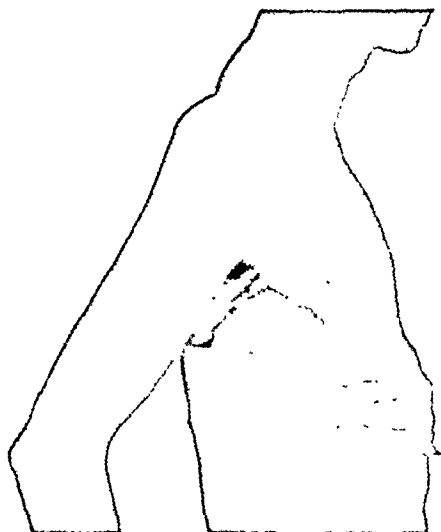


FIG. 10. Case VIII. Photograph after complete recovery. A strip of elastikon is worn for comfort because of motion, still present, in lower ribs. It has since been discarded and the chest wall has become rigid. (From *Ann. Surg.*)

even a minor thoracotomy. For this very reason, that he was hopeless without a surgical miracle, I advised intervention and made a tiny drainage opening. Later it was enlarged and eventually several operations for the obliteration of the pleural cavity were done with final complete restoration to health. The patient recovered and leads a life of normal activity in business. (Figs. 9 and 10.)

CASE IX. *Sudden acute perforation of pulmonary cavity. Pyopneumothorax.*

Dr. S. V., aged forty-five, had been ill for nine years with bilateral tuberculosis which had become arrested on the right side while on the left there was an uncollapsible large apical cavity. Mixed infection with perforation occurred in February 1926. There was a large bronchopleural fistula and the patient was constantly coughing and expectorating. A phthisiologist of international reputation had strongly urged against operation of any kind. Dr. Golembe of Liberty, New York, however, a man of broad vision, felt that life could go on but a short time as things were and referred the patient to me. Thoracotomy gave relief at once,

and thoracoplasty reduced the size of the infected pleural space. The bronchial fistula, however, did not close and the patient feeling that he is able to lead an almost normal life, in spite of the slightly discharging fistula, refuses further procedures.

CASE X. *Bilateral disease, right stationary. Left pyopneumothorax with sepsis; bronchial fistula.*

Mrs. G. W., aged thirty, had had a rapidly progressing tuberculosis for a year with fibrocavernous condition on the left side, the right having become stationary in a fibrosing condition with no cavities. On the left there were empyema and a bronchopleural fistula. When I first saw her she had fever, continuous cough and a large quantity of expectoration. A thoracotomy had been effected but drainage was still insufficient. In December 1928 I revised the thoracotomy with improvement; then thoracoplasty and finally injection of iodoform and vaseline 50 per cent were the procedures employed. Prompt and apparently complete recovery followed.

RECAPITULATION AND CONCLUSION

In an elementary manner this essay is intended to demonstrate how surgery can aid in checking the progress of pulmonary phthisis.

1. It states that there is an inherent inclination toward healing in organs which exhibit the effects of tuberculous infection.

2. That rest in the mechanical and physiological meaning of the word, is the end to be attained, and in order that rest may be complete perfect drainage is requisite whenever there is something to drain. That when there is no cavity to be drained, as in early tuberculous pneumonitis, rest may prevent extension of the disease and will aid in hastening fibrosis.

3. Most of the ordinary operative methods and their possible results are described in a few words.

4. Statistics and their value are superficially discussed.

The duty of the surgeon will now be outlined according to my personal opinion and viewpoint and I hope that physicians, too, will see that operative therapy holds out hope in many cases when all else has failed. It is my earnest wish that this

essay may especially stimulate the consciousness of those who are intrusted with the care of the tuberculous so that too much time and vitality may not be wasted before the idea of operative treatment is seriously considered.

By this I do not mean that there should be a demand for "early operation" as in cancer. Malignant neoplasms show no tendency to disappear spontaneously¹ while I have emphasized the well-known healing trend of tuberculosis. The challenge which the surgeon feels on the presentation of mere roentgenological evidence of surgical curability and the great danger of precipitate action was brought home to me some years ago in a manner which I shall not forget.

During an informal conference of surgeon, roentgenologist and phthisiologist at Loomis Sanatorium, Dr. Amberson presented the x-ray picture of a patient and requested an opinion as to the proper therapy for this case. There were the characteristic appearances of advanced fibrocavernous right-sided disease with a left lung remarkably free from lesions. I remember that the upper half of the affected lung presented clearly marked evidence of cavities of large size and that there were opacities representing scattered areas of consolidation. As I recollect this film, there was little or no retraction of the right thorax. Without asking any questions I stated that this case appeared suitable for thoracoplastic compression when, to my amazement 8 or 9 subsequent films of the same chest were displayed revealing steady improvement; the final picture, four years after the first, being that of an almost normal thorax! And this result had been attained by purely medical and hygienic means, not even pneumothorax having been employed. The joke was on me, although no one would have actually operated in this, or in any case of tuberculosis, without knowing its course from the inception. In any destructive infection of the lung, tuberculous or otherwise, one should not operate in the face of steady improvement, nor hold off too long when there is progressive destruction.

¹ At any rate this phenomenon is so unusual that, practically, it may be disregarded.

In the ten illustrative cases which have been presented here not one could have gone on to restoration of health but all would almost surely have perished. A few months was the longest estimated term of life and some patients were in a state which could only be described as *premoribund*, if I may coin a word. There are three deaths in this list; a far better showing than my general mortality rate. I intend to publish elsewhere the results of all of my operations, without regard to any postoperative time limit.

When a tuberculous patient has become hopeless under medical treatment and when it is known that a certain number of similar cases have shown definite and lasting improvement, even cure, following operation, I maintain that nothing stands in the way of operative therapy except the fear of a high mortality rate; or as this is sometimes paraphrased, the *discredit of surgery*. But, surely it cannot be to the credit of surgery to refuse help in any case no matter how desperate. I cannot imagine a surgeon's refusal to operate for strangulated hernia, even if the patient seemed to be near his end and even though he were at the same time suffering from another apparently fatal disease such as phthisis or advanced *néphritis*. Yet I have seen a patient die of tense pneumothorax from the perforation of a pulmonary cavity into the pleura, when respite might have been afforded by paracentesis or minor thoracotomy.

Who shall say when death is inevitable? Most of us will call to mind some farewell visit to a dying patient who next day greeted us with a "good morning."

It seems but yesterday when a massive pulmonary embolism meant certain and almost instant death; but thanks to the originality—yes, even to the valor of grand old Trendelenburg, some of these who were apparently dead have been resuscitated.

The true physician never gives up while there is life; and the true surgeon must not withhold his help merely to improve his record.

OBSERVATIONS ON THE
REACTION OF BRONCHIAL FISTULAE TO
ACUTE INFECTIONS
OF THE UPPER RESPIRATORY TRACT*

EVARTS A. GRAHAM, M.D., F.A.C.S.

ST. LOUIS, MO.

A FREQUENT phenomenon in those patients who have bronchial fistulae is the occurrence of an acute inflammation of the bronchial mucous membrane in the presence of an acute infection of the upper respiratory tract. This fact was brought to the attention of Dr. J. J. Singer and myself for the first time in 1924, by observing a patient who had a fistula leading into one of the larger bronchi of a lower lobe of the lung following the operation of cautery pneumonectomy. The discharge from the fistula ordinarily was so slight as to consist only of enough mucus secreted during the day to make a small spot on the dressings. When, however, the patient developed an acute infection of the nasal sinuses the mucous membrane of the exposed bronchus was seen to become red and swollen and to discharge large quantities of secretion which at first was almost pure mucus but later became mucopurulent. This observation has been extended to include many other cases since that first one, probably in all about fifty. The local manifestations of acute infection in the bronchus usually do not appear until about twenty-four hours after the onset of the acute sinus disease. With the subsidence of the acute infection in the nasal sinuses the local reaction in the bronchus also subsides. The mucous membrane loses its swelling, assumes a more nearly normal color, and the amount of secretion of mucus greatly diminishes. Bacteriological examinations of the secretion from the nasal

*From the Department of Surgery, Washington University Medical School, and Barnes Hospital.

sinuses and from the exposed bronchus almost always reveal the same organism. In many of the cases in which the examination was made the prevailing organism has been streptococcus.

The importance of these observations lies in the relationship which they indicate to exist between the upper and the lower respiratory tracts. It is a well-known fact that the symptoms of a bronchiectasis even when involving a lower lobe of the lung are usually aggravated by the presence of infection in the nasal sinuses. Conversely the clearing of an infection in the nasal sinuses in a patient with bronchiectasis will usually result in a diminution in the amount of secretion which is coughed up. Occasionally it happens that the removal of polypi from the nasal sinuses of a bronchiectatic patient results in so marked a reduction of the amount of sputum and other distressing symptoms that the patient is able to take up an occupation from which he would otherwise be debarred. The observation that in the presence of acute infections of the nasal sinuses there is also a corresponding involvement of the lower bronchial tree, which has been made by direct visualization of an exposed bronchus, so far as I know has not been recorded before. It is chiefly for this reason as well as to express my admiration for the magnificent career of Rudolph Matas that I desire to record these observations here.

The question of how the infection spreads from a nasal sinus to the lower portions of the bronchial tree is one which cannot be answered with entire satisfaction. Whether it spreads through the lymphatics or by direct extension by contiguity is still a question which so far as I know cannot be settled at the present time.

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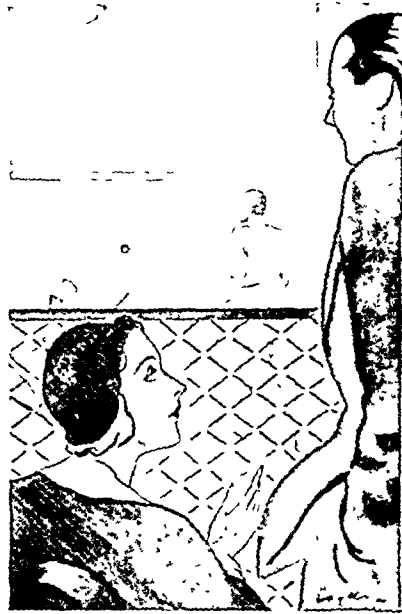
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Harris, F. I., and Bolze, E.: Basic principles involved in modern
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Russell, T. H.: Spinal anesthesia. *Am. J. Surg.* 6:201, 1929.

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Bessesen, D. H.: The safety of spinal anesthesia. *Med. J. & R.*
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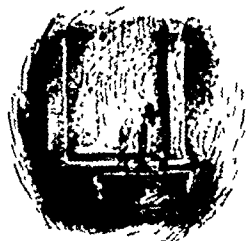
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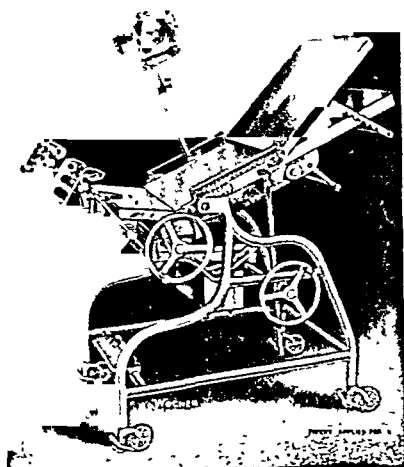
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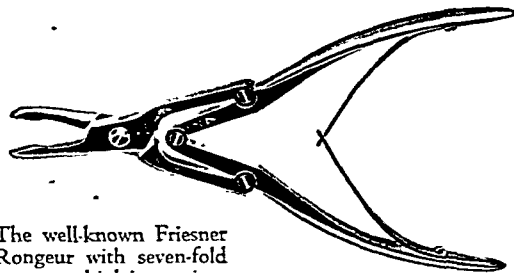
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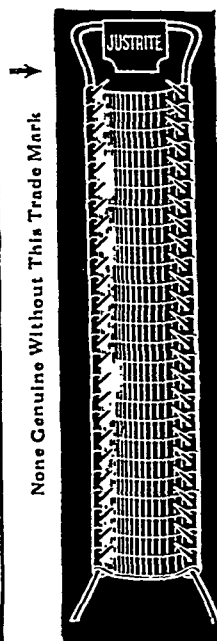
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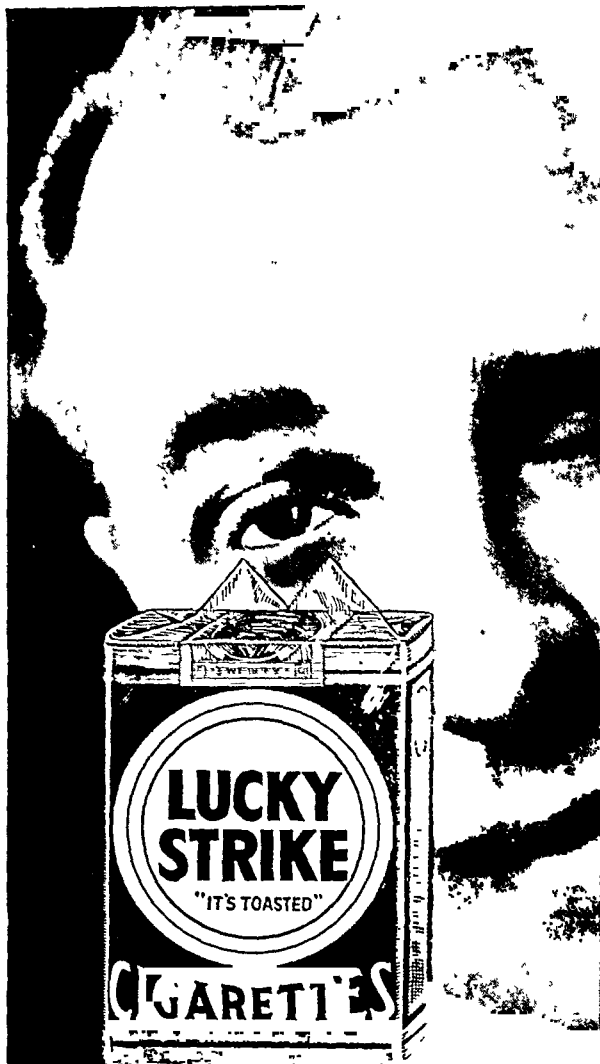
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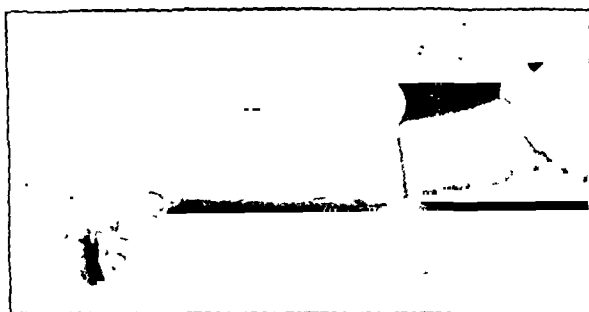
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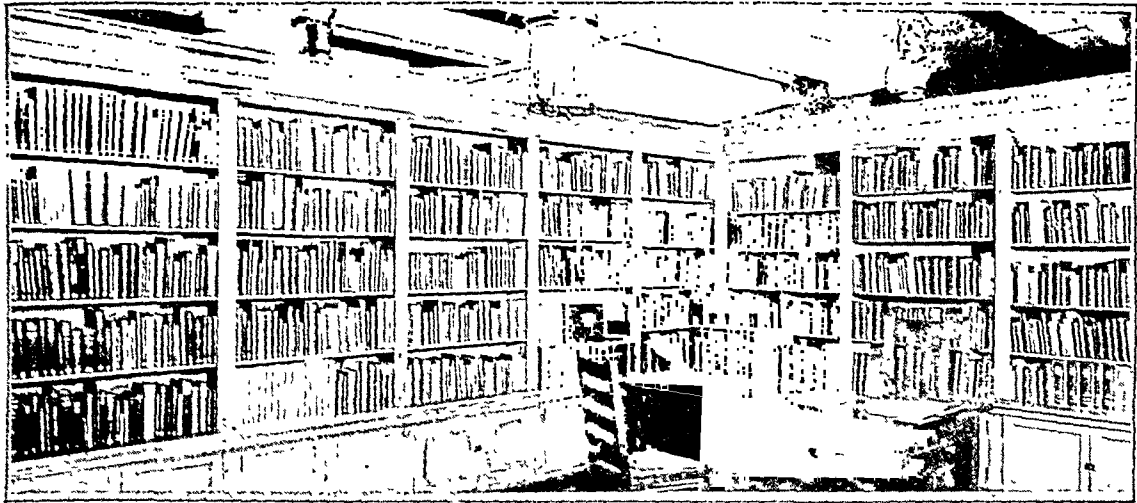
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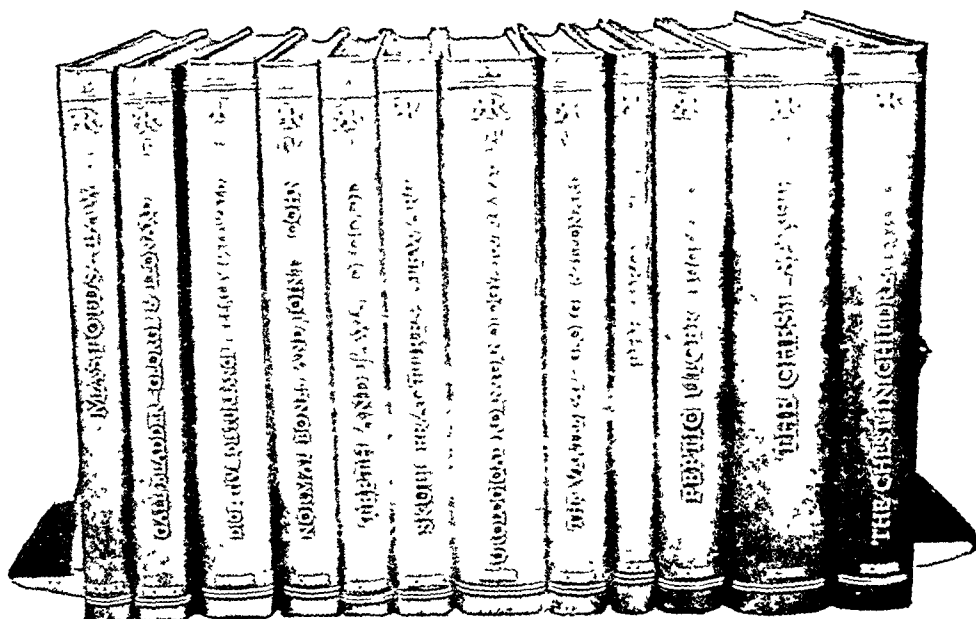
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